SOIL SURVEY OF

Door County, Wisconsin

United States Department of Agriculture
Soil Conservation Service
In cooperation with
Research Division of the
College of Agricultural and
Life Sciences
University of Wisconsin

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in the period 1970–74. Soil names and descriptions were approved in 1975. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1975. This survey was made cooperatively by the Soil Conservation Service and the Research Division of the College of Agricultural and Life Sciences, University of Wisconsin. Fieldwork was partly financed by the Door County Soil and Water Conservation District. This survey is part of the technical assistance furnished to the Door County Soil and Water Conservation District.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, recreation, and residential development.

Locating Soils

All of the soils in Door County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification and woodland suitability subclass of each. It also shows the page where each soil is described.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units and woodland management and productivity.

Foresters and others can refer to the sections "Woodland management and productivity" and "Windbreaks and environmental plantings" where the soils of the county are rated according to their suitability for trees and expected growth in 20 years of trees planted for windbreaks and environmental plantings.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Wildlife habitat."

Community planners and others can read about soil properties that affect the choice of sites for dwellings, industrial buildings, and for recreation areas in the sections "Engineering" and "Recreation."

Engineers and builders can find, under "Soil properties," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the sections "Formation of the soils" and "Classification of the soils."

Newcomers in Door County may be especially interested in the section "General soil map," where broad patterns of soils are described. They may also be interested in the information about the county given in the section "Factors affecting soil use."

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SOIL SURVEY OF DOOR COUNTY, WISCONSIN

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DOOR COUNTY is in the eastern part of Wisconsin, occupying most of the peninsula that separates Green Bay from Lake Michigan (fig. 1). Washington Island is separated from the tip of the peninsula by Porte des Morte Passage, which is about 4 miles across at its narrowest point. Several smaller islands, as far as 8 miles from the mainland, are also included in the county.

Door County is bordered by Kewaunee County on the south. The peninsula is 18 miles wide at the base and gradually tapers to about 4 miles. Its shores are indented by numerous bays and harbors. There are over 200 miles of shoreline in the county. The distance from the extreme southwest corner of the county to Gills Rock at the northern tip of the peninsula is nearly 60 miles. The total area of the survey area is 314,560 acres.

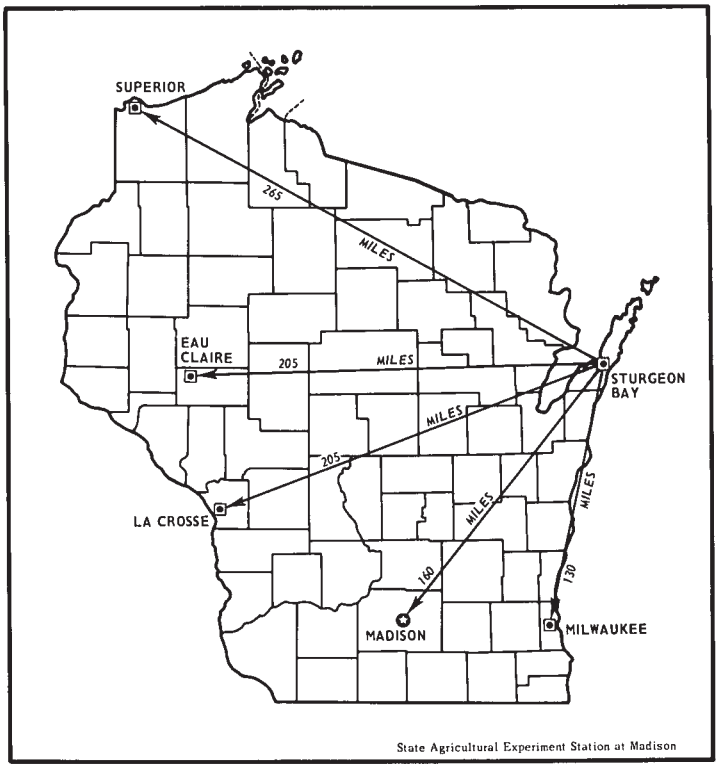

Figure 1.—Location of Door County in Wisconsin.

Sturgeon Bay, the county seat, with a population of 7,200 in 1970, is the largest city in Door County. It is the center of the agricultural area and serves as a distribution center for most of the county. Shipbuilding is the leading industry.

Egg Harbor, Fish Creek, Ephriam, Sister Bay, and Ellison Bay are small coastal villages north of Sturgeon Bay. They are noted summer resort areas that attract thousands of tourists each year. Numerous state and county parks add to recreational assets of Door County.

Dairying is the main source of farm income in the county. Orchard crops also are important to the farm economy. The number of dairy farms as well as the acreage of orchard crops has declined in recent years. Common farm crops are alfalfa, oats, and corn.

The most prominent topographic feature in the county is the long line of rugged bluffs bordering Green Bay, extending almost unbroken from a short distance north of Sturgeon Bay to the northeast point of the peninsula. In some places the bluffs reach the water's edge, but elsewhere they are some distance from the shore. These bluffs rise to an elevation of 200 feet above the bay. Dolomite escarpments and outcrops are quite abundant in the vicinity of and north of Sturgeon Bay.

The topography of Door County is modified by glaciation and is influenced, to a large extent, by the underlying bedrock. Most of the soils in the county formed in glacial till. Characteristically, the soils have a reddish brown heavy loam subsoil over a light brown, permeable loam or sandy loam substratum. These soils mostly have slight or moderate limitations for farming and residential development.

Other soils in the survey area formed in slowly permeable silty clay glacial till, outwash sand and gravel, or lacustrine sediment. In many places, soils are underlain by dolomite bedrock at a depth of less than 5 feet. Swamps and high water table depressions, typical of a glaciated region, are also scattered throughout the survey area. Soils that are slowly permeable, shallow over bedrock, wet, or steep have severe limitations for septic tank absorption fields.

How this survey was made

Soil scientists made this survey to learn what kinds of soil are in Door County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they

had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes; the size and speed of streams; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in nearby counties and in more distant places. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Emmet and Longrie, for example, are the names of two soil series. All of the soils in the United States that have the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Emmet sandy loam, 2 to 6 percent slopes, is one of several phases in the Emmet series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in accurately drawing boundaries. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be used in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series or of different phases within one series. One such kind of mapping unit is shown on the soil map of Door County, the soil complex.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Generally, the name of the soil complex consists of the names of the dominant soils, joined by a hyphen. Rock outcrop-Namur complex, 6 to 20 percent slopes, is an example.

In most surveyed areas there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been classified by soil series. These places are shown on the soil map and are described in the survey, but they are called miscellaneous areas and are given descriptive names such as Rock outcrop.

While a soil survey is in progress, soil scientists take soil samples needed for laboratory measurements and for engineering tests. Laboratory data from the same kind of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kind of soil. Yields under defined management are estimated for all the soils.

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants; and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this to the slow permeability of the soil or its high water table. They see that streets, road pavements, and foundations for houses are cracked on a named kind of soil, and they relate this failure to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General soil map

The general soil map at the back of this survey shows, in color, the soil associations in the survey area. A soil association is a landscape that has a distinctive pattern of soils in defined proportions. It typically consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in an association can occur in others, but in different patterns.

A map showing soil associations is useful to people who want to have a general idea of the soils in a survey area, who want to compare different parts of that area, or who want to locate large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide for broad planning on a watershed, a wooded tract, or a wildlife area; or for broad planning of recreational facilities, community developments, and such engineering works as transportation corridors. It is not a suitable map for detailed planning for management of a farm or field or for selecting the exact location of a road or building or other structure, because the soils within an association ordinarily vary in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The six soil associations in Door County are discussed in the following pages. Soil associations and delineations on the general soil map do not fully agree with those of the general soil maps of adjacent counties published at a different date. Differences in the maps are the result of improvement in the classification of soils, particularly in the modifications or refinement in soil series concepts. In addition, more precise and detailed maps are needed because the uses of the general soil maps have expanded in recent years. The more modern maps meet this need. Still another difference is the pattern of occurrence of the major soils or the range in slope that is permitted within associations in different surveys.

1. Summerville-Longrie-Omena association

Shallow to deep, well drained, nearly level to moderately steep soils that have a sandy loam or loam subsoil over sandy loam or fine sandy loam till or dolomite bedrock

This association consists of nearly level to moderately steep soils on upland till plains and ridges where bedrock strongly influences topography. It occupies about 48 percent of the county. Summerville soils make up about 24 percent of the association; Longrie soils, about 20 percent; Omena soils, about 20 percent; and minor soils, 36 percent.

The Summerville soils are well drained and are nearly level to moderately steep. They are on glacial till upland plains and ridges. These soils are underlain by dolomite bedrock at a depth of 10 to 20 inches. Typically, the surface layer is loam, and the subsoil is loam. Dolomite bedrock is at a depth of about 15 inches.

The Longrie soils are well drained and are nearly level to sloping. They are on glacial till upland plains and ridges. These soils are underlain by dolomite bedrock at a depth of 20 to 40 inches. Typically, the surface layer is loam, and the subsurface layer is sandy loam. The subsoil is sandy loam in the upper part and loam in the lower part. The substratum, at a depth of about 23 inches, is fine sandy loam glacial till that is underlain by dolomite bedrock at a depth of about 30 inches.

The Omena soils are well drained and are gently sloping to moderately steep. They are on glacial till upland plains and ridges. Typically, the surface layer is sandy loam. The subsoil is sandy loam in the upper part and loam in the lower part. The substratum, at a depth of about 17 inches, is sandy loam glacial till.

Minor soils in this association are mainly Alpena, Bonduel, Bonduel Shallow Variant, Bonduel Wet Variant, Namur, and Solona soils. The Alpena soils are on extinct glacial lake beach ridges generally near the shorelines of the extinct lake. The Namur soils are along escarpments or areas of exposed dolomite bedrock. The Bonduel, Bonduel Shallow Variant, Bonduel Wet Variant, and Solona soils are in wet drainageways and depressions throughout the association.

Most moderately deep and deep soils of this association are used for cultivated crops, such as corn, small grain, and legumes. A few steeper areas and undrained wet areas are used for pasture or wildlife habitat. Much of the area of shallow soils is used for pasture or remains in woodland or wildlife habitat.

The gently sloping, moderately deep and deep soils are suited or moderately well suited to crops. The shallow and steeper soils are moderately well suited to generally unsuited to crops.

Controlling erosion and maintaining organic-matter content, tilth, and fertility are the main concerns of management for cultivation. Where the wet soils are adequately drained, they are used for crops commonly grown in the county.

2. Emmet-Solona-Angelica association

Deep, well drained to poorly drained, nearly level to sloping soils that have a loamy sand to silt loam subsoil over sandy loam or loam till

This association consists of nearly level to sloping soils on upland till plains and broad ridges. It occupies about 23 percent of the county. Emmet soils make up about 44 percent of the association; Solona soils, 16 percent; Angelica soils, 10 percent; and minor soils, 30 percent.

The Emmet soils are well drained and are gently sloping to sloping. They are on glacial till plains and broad ridges. Typically, the surface layer is sandy loam. The subsoil is loamy sand and sandy loam in the upper part and loam and sandy loam in the lower part. The substratum, at a depth of about 34 inches, is sandy loam glacial till.

The Solona soils are somewhat poorly drained and are nearly level. They are in drainageways and small depressions. Typically, the surface layer is loam. The subsoil is silt loam in the upper part and loam in the lower part. The substratum, at a depth of about 27 inches, is sandy loam glacial till.

The Angelica soils are poorly drained and are nearly level. They are in broad drainageways and depressions. Typically, the surface layer and subsoil are loam. The substratum, at a depth of about 25 inches, is loam glacial till.

Minor soils of this association are mainly Cathro, Omena, Omro, Longrie, Namur, and Summerville soils. The Cathro soils are in potholes and broad depressions. The Omena soils are moderately steep and steep and are on drumlin ridges (fig. 2). The Omro soils are gently sloping and are in upland areas where this association borders the Kewaunee-Kolberg-Manawa association. The Longrie, Namur, and Summerville soils are along escarpments where glacial till is underlain by dolomite bedrock.

Most well drained soils and artificially drained soils of this association are used for cultivated crops such as corn, small grain, and legumes. Undrained wet areas are used mainly for pasture, woodland, and wildlife habitat.

The well drained soils and artificially drained soils are well suited or moderately well suited to crops commonly grown in the county. Controlling erosion and maintaining organic-matter content, tilth, and fertility are the main concerns of managing the well drained soils for cultivation. Adequate drainage systems are needed in the somewhat poorly drained to very poorly drained soils.

3. Rousseau-Kiva-Markey association

Deep, well drained and moderately well drained, gently

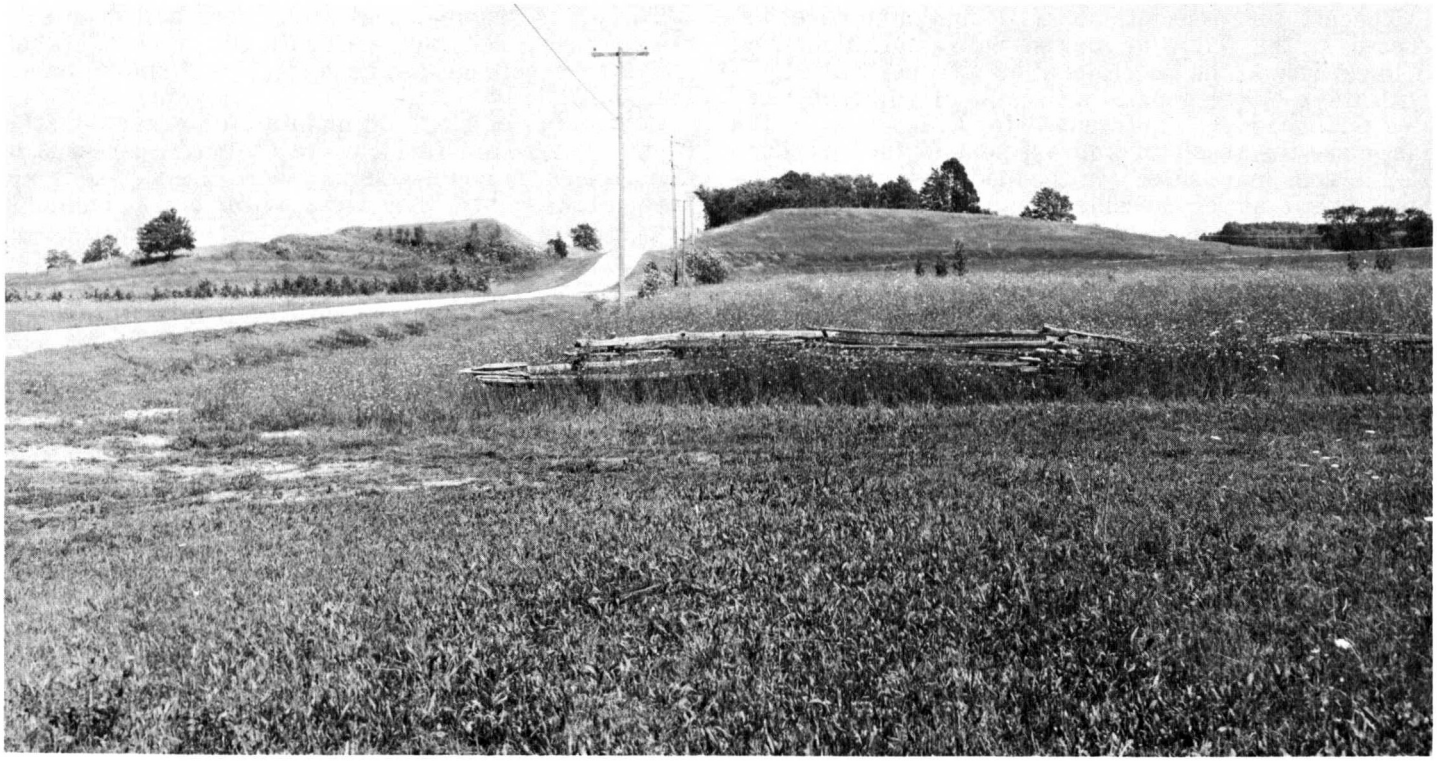

Figure 2.—**Omena soils occupy much of the drumlin landscape in Liberty Grove Township.**

sloping and sloping soils that have a fine sand or sandy loam subsoil over sand or sand and gravel outwash, and very poorly drained, nearly level organic soils

This association consists of nearly level to sloping soils on outwash plains, on stabilized dunes, on beach ridges, and in depressions. It occupies about 6 percent of the county. The Rousseau soils make up about 28 percent of the association; Kiva soils, about 16 percent; Markey soils, about 15 percent; and minor soils, 41 percent.

The Rousseau soils are well drained and moderately well drained and are gently sloping and sloping. They are on sandy outwash plains and stabilized dunes. Typically, the surface layer and subsoil are fine sand. The substratum, at a depth of about 27 inches, is fine sand.

The Kiva soils are well drained and are gently sloping or sloping. They are on old beach ridges. Typically, the surface layer is gravelly loam, and the subsurface layer is sandy loam. The subsoil is sandy loam. The substratum, at a depth of about 18 inches, is stratified outwash sand and gravel.

The Markey soils are very poorly drained, nearly level mucks. They are in many of the depressions of this association. The organic material in these soils is derived primarily from herbaceous plants. It is underlain by an outwash sand substratum at a depth of about 28 inches.

Minor soils of this association are mainly Boyer, Duel, Sisson, and Wainola soils. The Boyer soils are intermingled with the gently sloping Rousseau soils. The Duel soils are along escarpments where the sandy outwash deposits are underlain by dolomite bedrock at a depth of less than 40 inches. The Sisson soils are on broad ridgetops and the Wainola soils are in drainageways and along the edge of depressions adjacent to the Markey soils.

Most of this association is used for pasture, woodland, or wildlife habitat.

The soils are poorly suited or generally unsuited to the crops commonly grown in the county. They are better suited to trees. Planting adapted species, such as red pine, in cleared and open areas will help to control erosion. This association is better suited to recreation and community development than most other associations in the county.

4. Kewaunee-Kolberg-Manawa association

Deep and moderately deep, well drained and somewhat poorly drained, nearly level to moderately steep soils that have a dominantly silty clay subsoil over silty clay till or dolomite bedrock

This association consists of nearly level to moderately steep soils on glacial till upland plains and ridges where, in places, bedrock has a strong influence on topography. It occupies about 11 percent of the county. The Kewaunee soils make up about 39 percent of the association; Kolberg soils, about 15 percent; Manawa soils, about 14 percent; and minor soils, 32 percent.

The Kewaunee soils are well drained and are nearly level to moderately steep. They are on glacial till upland plains and ridges. Typically, the surface layer is silt loam, and the subsoil is clay loam in the upper part

and silty clay in the lower part. The substratum, at a depth of about 28 inches, is silty clay glacial till.

The Kolberg soils are well drained and are nearly level to sloping. They are on glacial till upland plains and broad ridges. These soils are underlain by dolomite bedrock at a depth of 20 to 40 inches. Typically, the surface layer is silt loam. The subsoil is clay loam in the upper part, silty clay in the middle part, and silty clay loam in the lower part. The substratum is heavy loam. Dolomite bedrock is at a depth of about 38 inches.

The Manawa soils are somewhat poorly drained and are nearly level. They are in drainageways and small depressions on glacial till upland plains. Typically, the surface layer is silt loam, and the subsoil silty clay. The substratum, at a depth of about 28 inches, is silty clay glacial till.

Minor soils in this association are Manistee, Namur, Poygan, Suamico, and Kolberg Variant soils. The Manistee soils are on broad ridge crests intermingled with the Kewaunee soils. The Namur and Kolberg Variant soils are along escarpments where the glacial till is thin over the underlying dolomite bedrock. The Poygan soils are in broad drainageways and swales, and the Suamico soils are in large depressions that are scattered throughout the association.

Most of this association is used for cultivated crops such as corn, small grain, and legumes. Scattered steeper areas or undrained wet areas are used for pasture, woodland, or wildlife habitat.

The well drained, nearly level to gently sloping soils as well as the artificially drained soils are well suited to moderately well suited to the common farm crops. Steeper soils are poorly suited to crops commonly grown in the county. Controlling erosion and maintaining organic-matter content, tilth, and fertility are the main concerns in managing the well drained soils of this association. Adequate drainage is needed to maintain production of the somewhat poorly drained, poorly drained, and very poorly drained soils.

5. Deford-Yahara Variant-Carbondale association

Deep, poorly drained, nearly level soils that are underlain by fine sand outwash or that have a silt loam subsoil over stratified lake sediments, and very poorly drained, nearly level organic soils

This association consists of nearly level soils in glacial lake basins and on outwash plains. It occupies about 5 percent of the county. Deford, Yahara Variant, and Carbondale soils each make up about 14 percent of the association, and minor soils make up 58 percent.

The Deford soils are poorly drained and are nearly level. They are on glacial lake and outwash plains. Typically, the surface layer is loamy fine sand. The fine sand outwash substratum is at a depth of about 4 inches.

The Yahara Variant soils are poorly drained and are nearly level. They are on glacial lake plains. Typically, the surface layer and subsoil are silt loam. The substratum, at a depth of about 23 inches, is stratified silt, fine sand, and silty clay loam lake sediment.

The Carbondale soils are very poorly drained deep mucks. They are in broad depressions. The organic material in these soils is derived mainly from herbaceous plants.

Minor soils in this association are mainly Markey, Rousseau, Deford, Wainola, and Yahara soils. The Markey soils are in small depressions and along the edges of large depressions. The Wainola and Yahara soils are on benches or terraces in areas adjacent to Deford and Yahara Variant soils. The Rousseau and Deford soils are on low ridges and in swales that were formed by the high lake elevation of the post-glacial period. They are in low–lying areas along Lake Michigan.

This association is used mostly for pasture, woodland, and wildlife habitat.

These soils are moderately well suited or poorly suited to crops.

6. Carbondale-Cathro association

Very poorly drained, nearly level organic soils

This association consists of nearly level organic soils in glacial lake basins and depressions. It occupies about 7 percent of the county. The Carbondale soils make up about 49 percent of the association; Cathro soils, about 23 percent; and minor soils, 28 percent.

The Carbondale soils are very poorly drained mucks. They are in broad glacial lake basins and depressions. The organic material of these soils is derived primarily from herbaceous plants.

The Cathro soils are very poorly drained mucks. They are in small glacial lake basins and depressions or along the edge of larger depressions. The organic material of these soils is derived primarily from herbaceous plants. It is underlain by a loam and clay loam substratum at a depth of about 30 inches.

Minor soils in this association are Allendale, Angelica, and Pinconning soils. All of these soils are along the edges of the areas of Carbondale and Cathro soils.

Most of this association is used for pasture, woodland, or wildlife habitat.

These soils are poorly suited to crops.

Descriptions of the soils

This section describes the soil series and mapping units in Door County. Each soil series is described in detail, and then, briefly, each mapping unit in that series. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. Color terms are for moist soil unless otherwise stated. The profile described in the series is representa-

tive of mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit, or they are apparent in the name of the mapping unit.

As mentioned in the section "How this survey was made," not all mapping units are members of a soil series. Beaches, for example, does not belong to a soil series, but nevertheless is listed in alphabetic order with the soil series.

Preceding the name of each mapping unit is a symbol. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit are the capability unit and woodland suitability subclass in which the mapping unit has been placed. The page for the description of each woodland suitability subclass can be found by referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary at the end of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*6*).[1]

Allendale series

The Allendale series consists of somewhat poorly drained, nearly level and gently sloping soils on lacustrine plains or till plains. The native vegetation is American elm, white ash, and white birch.

In a representative profile the surface layer is very dark gray loamy sand about 9 inches thick. The subsurface layer is brown sand about 11 inches thick. The subsoil is about 10 inches thick and is mottled; it is brown, loose sand in the upper part and reddish brown, very firm silty clay in the lower part. The substratum is reddish brown, mottled, very firm silty clay to a depth of about 60 inches.

The available water capacity is moderate. Permeability is rapid in the sandy part and slow in the clayey part of the profile. These soils are seasonally saturated at a depth of 0.5 to 1.5 feet unless they are drained. The depth of the root zone is limited by the water table in undrained areas. Natural fertility and the organic-matter content of the surface layer are low.

If drained, most areas of these soils are used for pasture or for general farm crops commonly grown in the county. Undrained areas provide good wetland wildlife habitat. Some areas are used for unimproved pasture.

Representative profile of Allendale loamy sand, 0 to 3 percent slopes, in a cultivated field, 600 feet south and 900 feet west of the northeast corner of the SE¼ sec. 33, T. 27 N., R. 26 E.:

Ap—0 to 9 inches; very dark gray (10YR 3/1) loamy sand; very weak medium granular structure; very friable; slightly acid; abrupt smooth boundary.

A2—9 to 20 inches; brown (10YR 5/3) sand; single grained; loose; neutral; clear, irregular boundary.

B2ir—20 to 24 inches; brown (7.5YR 5/4) sand; common medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/8) mottles; single grained; loose; mildly alkaline; clear irregular boundary.

A'2—24 to 26 inches; brown (10YR 5/3) sand; single grained; loose; neutral; contains about 15 percent gravel, by volume; mildly alkaline; abrupt irregular boundary.

IIB'2t—26 to 30 inches; reddish brown (5YR 5/3) silty clay; common medium distinct pale brown (10YR 6/3) and yellowish red (7.5YR 5/8) mottles; moderate medium angular blocky structure; very firm; few patchy clay films on ped faces and in old root channels; mildly alkaline; clear wavy boundary.

IIC—30 to 60 inches; reddish brown (5YR 5/4) silty clay; few medium distinct strong brown (7.5YR 5/8) mottles; weak medium angular blocky structure; very firm; strongly effervescent; mildly alkaline.

The sandy part of the solum is 20 to 36 inches thick. The solum is generally slightly acid to mildly alkaline. The upper part of the solum ranges to strongly acid in some pedons. The Ap horizon is loamy sand or sandy loam and is very dark gray or very dark grayish brown in cultivated areas and black in uncultivated areas. The A2 and Bir horizons are sand, loamy sand, or loamy fine sand. The A'2 horizon is sand or loamy sand. It is as much as 15 percent gravel in some pedons, but typically it ranges from 10 to 15 percent gravel, by volume. The IIB and IIC horizons are mainly silty clay but range to clay. The C horizon is less than 5 percent coarse fragments, by volume.

In the survey area, the Allendale soils have less well expressed A2 and B2ir horizons and are more alkaline in the B'2 horizon than defined in the range for the series. These differences do not alter their usefulness and behavior.

Allendale soils are near Pinconning soils. They form a drainage sequence with the poorly drained Pinconning soils and the well drained Manistee soils.

AdA—Allendale loamy sand, 0 to 3 percent slopes. This nearly level and gently sloping soil is on lacustrine or till plains. Most areas are elongated and are 5 to 25 acres in size.

Included with this soil in mapping are small areas of Manistee and Pinconning soils. Also included are small areas of soils that have a sandy loam surface layer.

Runoff is slow. The hazard of erosion is slight. Wetness is the main limitation of this soil. This soil receives runoff from adjoining areas and can be ponded briefly in wet seasons and after heavy rains. Surface drains or field tile, or both, can be used to remove excess water if this soil is used for crops.

If drained, this soil is suited to corn, small grain, legumes such as red clover, and pasture. Undrained areas are used for unimproved pasture, for woodland, and for wetland wildlife habitat. Capability unit IIIw–6; woodland suitability subclass 3o.

[1] Italic numbers in parentheses refer to Literature Cited, p. 128.

TABLE 1.—*Acreage and proportionate extent of the soils*

Map symbol	Soil name	Acres	Percent
AdA	Allendale loamy sand, 0 to 3 percent slopes	510	0.2
ApC	Alpena gravelly sandy loam, 0 to 12 percent slopes	3,150	1.0
Ax	Angelica loam	8,900	2.8
Be	Beaches	450	0.1
Bn	Bonduel loam	7,400	2.4
Bo	Bonduel Shallow Variant fine sandy loam	2,550	0.8
Bp	Bonduel Wet Variant loam	2,800	0.9
BrB	Boyer loamy sand, 2 to 6 percent slopes	890	0.3
BrC	Boyer loamy sand, 6 to 12 percent slopes	770	0.2
BrD	Boyer loamy sand, 12 to 20 percent slopes	295	0.1
Ca	Carbondale muck	15,200	4.9
CcB	Casco sandy loam, 2 to 6 percent slopes	770	0.2
CcC2	Casco sandy loam, 6 to 12 percent slopes, eroded	310	0.1
Cm	Cathro muck	6,000	1.9
Cp	Chippeny muck	450	0.1
De	Deford loamy fine sand	2,400	0.8
DuB	Duel loamy sand, 1 to 6 percent slopes	1,000	0.3
Dv	Duel Variant sandy loam	560	0.2
EmA	Emmet sandy loam, 0 to 2 percent slopes	1,600	0.5
EmB	Emmet sandy loam, 2 to 6 percent slopes	32,850	10.4
EmC2	Emmet sandy loam, 6 to 12 percent slopes, eroded	4,800	1.5
EmD2	Emmet sandy loam, 12 to 20 percent slopes, eroded	350	0.1
EmE	Emmet sandy loam, 20 to 35 percent slopes	255	0.1
Fa	Fabius silt loam	440	0.1
Fu	Fluvaquents	440	0.1
Gp	Gravel pits	330	0.1
KhA	Kewaunee silt loam, 0 to 2 percent slopes	1,230	0.4
KhB	Kewaunee silt loam, 2 to 6 percent slopes	13,350	4.2
KhC2	Kewaunee silt loam, 6 to 12 percent slopes, eroded	1,250	0.4
KkD3	Kewaunee soils, 12 to 20 percent slopes, severely eroded	550	0.2
KmB	Kiva sandy loam, 2 to 6 percent slopes	2,550	0.8
KmC	Kiva sandy loam, 6 to 12 percent slopes	920	0.3
KoA	Kolberg silt loam, 0 to 2 percent slopes	1,150	0.4
KoB	Kolberg silt loam, 2 to 6 percent slopes	5,100	1.6
KoC2	Kolberg silt loam, 6 to 12 percent slopes, eroded	320	0.1
KvB	Kolberg Variant loam, 1 to 6 percent slopes	2,650	0.8
KvC2	Kolberg Variant loam, 6 to 12 percent slopes, eroded	315	0.1
LoA	Longrie loam, 0 to 2 percent slopes	6,600	2.1
LoB	Longrie loam, 2 to 6 percent slopes	26,750	8.5
LoC	Longrie loam, 6 to 12 percent slopes	1,450	0.5
McA	Manawa silt loam, 0 to 3 percent slopes	5,700	1.8
MeB	Manistee loamy sand, 2 to 6 percent slopes	630	0.2
Mk	Markey muck	5,500	1.7
NaB	Namur loam, 0 to 6 percent slopes	19,350	6.1
NaC	Namur loam, 6 to 12 percent slopes	1,800	0.6
Nv	Namur Variant loam	1,325	0.4
OmB	Omena sandy loam, 2 to 6 percent slopes	21,350	6.8
OmC	Omena sandy loam, 6 to 12 percent slopes	7,200	2.3
OmD	Omena sandy loam, 12 to 20 percent slopes	475	0.2
OvB	Omena Variant sandy loam, 2 to 6 percent slopes	1,650	0.5
OzB	Omro silt loam, 2 to 6 percent slopes	4,700	1.5
Pn	Pinconning loamy fine sand	710	0.2
Po	Poygan silty clay loam	1,650	0.5
Ra	Rock outcrop	1,600	0.5
Rb	Rock outcrop-Namur complex, 6 to 20 percent slopes	830	0.3
Rn	Rondeau muck	800	0.3
RoB	Rousseau fine sand, 2 to 6 percent slopes	4,900	1.6
RoC	Rousseau fine sand, 6 to 12 percent slopes	1,450	0.5
RpC	Rousseau-Shawano fine sands, 2 to 12 percent slopes	600	0.2
RpD	Rousseau-Shawano fine sands, 12 to 35 percent slopes	230	0.1
RrB	Rousseau-Deford fine sands, 2 to 6 percent slopes	2,300	0.7
Sa	Saprists	720	0.2
SnA	Sisson fine sandy loam, 0 to 2 percent slopes	270	0.1
SnB	Sisson fine sandy loam, 2 to 8 percent slopes	970	0.3
SoA	Solona loam, 0 to 3 percent slopes	15,400	4.9
Su	Suamico muck	1,550	0.5
SvA	Summerville loam, 0 to 2 percent slopes	5,600	1.8
SvB	Summerville loam, 2 to 6 percent slopes	30,400	9.7
SvC	Summerville loam, 6 to 12 percent slopes	2,550	0.8
SvD	Summerville loam, 12 to 20 percent slopes	545	0.2
Ud	Udipsamments	900	0.3
Uo	Udorthents, cobbly	1,230	0.4
Wa	Wainola loamy fine sand	2,200	0.7
YaA	Yahara fine sandy loam, 0 to 3 percent slopes	2,200	0.7
Yv	Yahara Variant silt loam	2,250	0.7
	Water	3,370	1.1
	Total	314,560	100.0

Alpena series

The Alpena series consists of well drained to excessively drained, nearly level to sloping soils on eskers and old glacial lake beach ridges. The native vegetation is sugar maple, red oak, and white-cedar.

In a representative profile the surface layer is black, gravelly sandy loam about 4 inches thick. The substratum, to a depth of about 12 inches, is brown, very friable, gravelly sandy loam. Below this, the substratum, to a depth of 60 inches, is pale brown, loose sand and gravel.

The available water capacity is very low, and permeability is rapid. These soils are seasonally saturated at a depth of more than 6 feet. The depth of the root zone is limited by sand and gravel. Natural fertility and the organic-matter content of the surface layer are low.

Most areas of these soils are used for pasture, woodland, and wildlife habitat. Some areas are a source of sand and gravel for highway construction and sites for residential development.

Representative profile of Alpena gravelly sandy loam, 0 to 12 percent slopes, at the edge of a gravel pit, 800 feet south and 700 feet west of the northeast corner of the SE¼ sec. 13, T. 30 N., R. 26 E.:

A1—0 to 4 inches; black (10YR 2/1) gravelly sandy loam; weak medium granular structure; very friable; about 40 percent gravel, by volume; mildly alkaline; clear wavy boundary.

C1—4 to 12 inches; brown (10YR 5/3) gravelly sandy loam; weak medium granular structure; very friable; about 40 percent gravel, by volume; mildly alkaline; clear wavy boundary.

IIC2—12 to 60 inches; pale brown (10YR 6/3) stratified gravelly sand; single grained; loose; strongly effervescent; mildly alkaline.

The solum is 4 to 7 inches thick and is neutral or mildly alkaline. The substratum is commonly mildly alkaline but ranges from neutral to moderately alkaline. The A1 horizon is very dark gray or black. The C1 horizon is dark brown, brown, or yellowish brown. Gravel is commonly smaller than 40 millimeters. The IIC horizon is well sorted and stratified and ranges from very gravelly sand to sand. Gravel content is more than 35 percent, by volume.

Alpena soils are near Casco, Kiva, and Longrie soils. They have a thinner solum than Kiva and Casco soils and lack the B horizon of those soils. Alpena soils have a sand and gravel substratum, whereas Longrie soils are underlain by dolomite bedrock at a depth of 20 to 40 inches.

ApC—Alpena gravelly sandy loam, 0 to 12 percent slopes. This nearly level to sloping soil is on old glacial lake beach ridges. Most areas are long and narrow and are 5 to 30 acres in size.

Included with this soil in mapping are small areas of Kiva soils. Also included are moderately steep Alpena soils and areas of soils in which dolomite bedrock is at a depth of 40 or more inches.

Runoff is slow. The hazard of erosion is slight to moderate. Droughtiness is the main limitation of this soil.

Most areas of this soil are used for permanent pasture, woodland, or wildlife habitat. Because of the very low available water capacity, this soil is generally unsuited to crops. Gravel pits are common in some areas. Capability unit VIs–5; woodland suitability subclass 4f.

Angelica series

The Angelica series consists of poorly drained, nearly level soils in depressions and waterways on glacial till plains. The native vegetation is tag alder, northern white-cedar, and white ash.

In a representative profile the surface layer is black loam about 5 inches thick. The subsoil is mottled, brown to dark brown, firm or friable loam about 20 inches thick. The substratum is yellowish brown and reddish brown, mottled, friable loam to a depth of 60 inches.

The available water capacity is high, and permeability is moderate to moderately slow. The soils are seasonally saturated at a depth of less than 1 foot unless they are drained. If these soils are not drained, the depth of the root zone is limited by the water table. Natural fertility is medium, and the organic-matter content of the surface layer is moderate.

If drained, most areas of these soils are used for pasture or for general farm crops commonly grown in the county. Undrained areas provide good wetland wildlife habitat. Some areas are used for unimproved pasture.

Representative profile of Angelica loam in an uncultivated area, 1,300 feet east and 300 feet north of the southwest corner of the SE¼ sec. 28, T. 26 N., R. 25 E.:

A1—0 to 5 inches; black (10YR 2/1) loam; weak fine and very fine subangular blocky structure; very friable; common roots; neutral; abrupt smooth boundary.

B21g—5 to 17 inches; brown to dark brown (7.5YR 4/2) loam; common medium faint reddish gray (5YR 5/2) and common medium distinct brown (7.5YR 4/4) mottles; moderate medium subangular blocky structure; firm; many roots; neutral; clear smooth boundary.

B22—17 to 25 inches; brown (10YR 4/3) loam; common medium prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; friable; few roots; neutral; clear wavy boundary.

C1—25 to 39 inches; yellowish brown (10YR 5/4) loam; common medium distinct reddish brown (5YR 4/3) and many medium distinct yellowish brown (10YR 5/6) mottles; massive; friable; strongly effervescent; mildly alkaline; gradual wavy boundary.

C2—39 to 60 inches; reddish brown (5YR 5/3) loam; many medium prominent yellowish brown (10YR 5/6) mottles; massive; friable; violently effervescent; moderately alkaline.

The solum is 16 to 30 inches thick and is slightly acid to neutral. The C horizon commonly is moderately alkaline, but thin horizons are mildly alkaline in some

pedons. In cultivated areas is a very dark brown Ap horizon as much as 8 inches thick. The B21 horizon ranges from dark gray to light brownish gray, and the B22 horizon ranges from dark grayish brown to light brown. The B21g and B22 horizons are commonly loam but range to sandy clay loam or clay loam in some pedons. The C horizon ranges from brown to pink. It is commonly loam but ranges to sandy loam or silt loam. Content of coarse fragments ranges from 10 to 20 percent, by volume.

Angelica soils are near Emmet, Omena, and Solona soils. They have finer texture and are more poorly drained than Omena soils. Angelica soils are wetter than Emmet and Solona soils.

Ax—Angelica loam. This nearly level soil is in drainageways and depressions on glacial till plains. Slopes are 0 to 2 percent. Most drainageways are elongated, and depressions are irregular in shape. Areas are 3 to 150 acres in size.

Included with this soil in mapping are small areas of Solona soils. Also included are small areas of Angelica soils that have slopes of 3 or 4 percent or that have a thin accumulation of alluvium.

Runoff is slow to ponded. The hazard of erosion is slight. Wetness is the main limitation of this soil. This soil receives runoff from adjoining areas and is often ponded during wet seasons and after heavy rains. Surface drainage removes excess water rapidly. Deep ditches and subsurface drainage provide internal drainage.

If drained, this soil is suited to corn, small grain, legumes such as red clover, and pasture. Some truck crops are also grown. Undrained areas are used for unimproved pasture but are better suited to wetland wildlife habitat than to most other uses. Capability unit IIw–1; woodland suitability subclass 3w.

Beaches

Be—Beaches. These miscellaneous areas consist of nearly level and gently sloping sandy, gravelly, and cobbly beach deposits in swales and on low ridges along major lakes. Slopes are 0 to 6 percent. There is no evidence of soil profile development in these deposits. These areas have little or no vegetation. They are submerged when the lake level is high and when wave action is intense. The water table is above a depth of 3 feet for a considerable part of the year.

These areas are unsuited to and are not used for cultivated crops or pasture because of wetness and the effect of wave action, especially when the lake level is high. Some areas are used for recreation. Capability unit VIIIs–10; woodland suitability subclass 6s.

Bonduel series

The Bonduel series consists of somewhat poorly drained, nearly level soils on glacial till plains. Dolomite bedrock is at a depth of 20 to 40 inches. The native vegetation is American elm, sugar maple, white ash, and some northern white-cedar.

In a representative profile the surface layer is very dark brown loam about 9 inches thick. The subsoil is about 19 inches thick; it is mottled, brown, friable loam in upper part; mottled, dark brown, firm light clay loam in the middle part; and mottled, brown, friable heavy loam and loam in the lower part. Below the subsoil is dolomite bedrock at a depth of about 28 inches.

The available water capacity is low, and permeability is moderate. These soils are seasonally saturated at a depth of 1 to 3 feet unless they are drained. If the soils are not drained, the depth of the root zone is limited by the water table. Natural fertility is medium, and the organic-matter content of the surface layer is moderate.

Where drained, most areas of these soils are used for pasture or for general farm crops commonly grown in the county. Undrained areas provide wetland wildlife habitat. Some areas are used for unimproved pasture.

Representative profile of Bonduel loam in a cultivated field, 1,040 feet north and 1,040 feet east of the southwest corner of the NW¼ sec. 17, T. 27 N., R. 25 E.:

Ap—0 to 9 inches; very dark brown (10YR 2/2) loam; moderate fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

B1—9 to 11 inches; brown (10YR 4/3) loam; many fine prominent yellowish red (5YR 5/6) and common fine faint grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; friable; neutral; clear smooth boundary.

B21t—11 to 17 inches; dark brown (7.5YR 4/4) light clay loam; common fine distinct yellowish red (5YR 5/6) and prominent light grayish brown (10YR 6/2) mottles; moderate medium subangular blocky structure; firm; few thin clay films on ped faces; neutral; gradual wavy boundary.

B22—17 to 23 inches; brown (10YR 5/3) heavy loam; common fine distinct yellowish red (5YR 5/6) and prominent light grayish brown (10YR 6/2) mottles; weak medium subangular blocky structure; friable; mildly alkaline; clear smooth boundary.

B3—23 to 28 inches; brown (10YR 5/3) loam; few fine distinct reddish yellow (7.5YR 6/6) mottles; weak fine subangular blocky structure; friable; strongly effervescent; moderately alkaline; abrupt smooth boundary.

R—28 inches; light gray (10YR 7/2) consolidated dolomite bedrock.

The solum is 20 to 34 inches thick. It is commonly neutral or mildly alkaline but ranges to medium acid in some pedons. The depth to consolidated dolomite bedrock is 20 to 40 inches. The A1 horizon, the A2 horizon where present, and the B1 horizon are loam or silt loam. The B2t and B3 horizons are commonly loam or clay loam, but range to silt loam or sandy clay loam in some pedons.

Bonduel soils are near Bonduel Wet Variant, Chippeny, Longrie, and Solona soils. They are not so wet as Bonduel Wet Variant soils and lack the organic surface horizons of Chippeny soils. Bonduel soils are wetter than Longrie soils. They are underlain by dolomite bedrock, whereas Solona soils are not.

Bn—Bonduel loam. This nearly level soil is on glacial till plains that are underlain by dolomite bedrock. Slopes are 0 to 2 percent. Most areas are irregular in shape and are 3 to 20 acres in size.

Included with this soil in mapping are small areas of Bonduel Wet Variant and Longrie soils. Also included are small areas of soils that have a fine sandy loam surface layer, small areas of soils that have a heavy clay loam subsoil, and areas of soils that are underlain by dolomite bedrock at a depth of 40 to 60 inches.

Runoff is slow. The hazard of erosion is slight. Wetness is the main limitation of this soil. This soil receives runoff from adjoining areas and is likely to be ponded briefly during wet seasons and after heavy rains. Surface drainage removes excess water rapidly. The underlying dolomite bedrock limits the use of deep ditches and subsurface drainage.

If drained, this soil is moderately well suited to corn, small grain, legumes such as red clover, and pasture. Some truck crops are also grown. Undrained areas are used for unimproved pasture but are better suited to wetland wildlife habitat than to most other uses. Capability unit IIw–3; woodland suitability subclass 3o.

Bonduel Shallow Variant

The Bonduel Shallow Variant consists of somewhat poorly drained, nearly level soils on glacial till plains where dolomite bedrock is at a shallow depth. The native vegetation is American elm, sugar maple, white ash, and some northern white-cedar.

In a representative profile the surface layer is very dark grayish brown fine sandy loam about 5 inches thick. The subsurface layer is mottled, brown fine sandy loam about 5 inches thick. The subsoil is about 7 inches thick and is mottled; it is dark brown, friable loam in the upper part and brown, friable sandy loam in the lower part. Dolomite bedrock is at a depth of 17 inches.

The available water capacity is low, and permeability is moderate. These soils are seasonally saturated at a depth of 1 to 3 feet unless they are drained. The depth of the root zone is limited by dolomite or by the water table in undrained areas. Natural fertility is medium, and the organic-matter content of the surface layer is moderate.

If these soils are drained, most areas are used for pasture or general farm crops commonly grown in the county. Undrained areas provide good wetland wildlife habitat. Some areas are used for unimproved pasture.

Representative profile of Bonduel Shallow Variant fine sandy loam in a wooded area, 600 feet west and 200 feet north of the southeast corner of sec. 28, T. 31 N., R. 27 E.:

A1—0 to 5 inches; very dark grayish brown (10YR 3/2) fine sandy loam; moderate fine subangular blocky structure; very friable; many roots; some dolomite fragments; mildly alkaline; clear smooth boundary.

A2—5 to 10 inches; brown (10YR 5/3) fine sandy loam; common medium faint grayish brown (10YR 5/2) and common medium prominent brownish yellow (10YR 6/6) mottles; weak medium subangular blocky structure; friable; many roots; some dolomite fragments; many worm casts; mildly alkaline; clear wavy boundary.

B2—10 to 14 inches; dark brown (7.5YR 4/4) loam; common fine distinct light brownish gray (10YR 6/2) and many fine prominent yellowish brown (10YR 5/8) mottles; weak medium subangular blocky structure; friable; dolomite fragments present; many roots; clay bridging of sand grains; mildly alkaline; clear wavy boundary.

B3—14 to 17 inches; brown (7.5YR 5/4) sandy loam; few fine distinct light brownish gray (10YR 6/2) and common fine prominent yellowish brown (10YR 5/8) mottles; weak medium subangular blocky structure; friable; many roots; clay bridging of sand grains; some dolomite fragments; mildly alkaline.

R—17 inches; light gray (10YR 7/2) consolidated dolomite bedrock.

Thickness of the solum and depth to dolomite bedrock are 10 to 20 inches. The solum is mildly alkaline. The B horizon is loam or sandy loam. A thin loam or sandy loam C horizon is present in some places.

Bonduel Shallow Variant soils are near Namur and Summerville soils. They are somewhat poorly drained, whereas Summerville and Namur soils are well drained. Bonduel Shallow Variant soils have dolomite bedrock at a depth of 10 to 20 inches, and Namur soils are underlain by dolomite bedrock at a depth of less than 12 inches.

Bo—Bonduel Shallow Variant fine sandy loam. This nearly level soil is on glacial till plains that are underlain by dolomite bedrock. Slopes are 0 to 2 percent. Most areas are irregular in shape and are 5 to 30 acres in size.

Included with this soil in mapping are small areas of Bonduel and Namur Variant soils. Also included are small areas of soils that have a loam or silt loam surface layer.

Runoff is slow. The hazard of erosion is slight. Wetness is the main limitation of this soil. This soil receives runoff from adjoining areas and is likely to be ponded briefly during wet seasons and after heavy rains. Surface drainage removes excess water rapidly. The underlying dolomite bedrock prevents the use of deep ditches and tile drains.

Even if drained, this soil is poorly suited to corn, small grain, legumes such as clover, and pasture. If overdrained, this soil is droughty and crop yields in most years are limited by low available water capacity. Undrained areas are used for unimproved pasture, but are better suited to wetland wildlife habitat than to most other uses. Capability unit IVw–5; woodland suitability subclass 4w.

Bonduel Wet Variant

The Bonduel Wet Variant consists of poorly drained, nearly level soils in depressions on glacial till plains where dolomite bedrock is at a depth of 20 to 40 inches. The native vegetation is tag alder, American elm, northern white-cedar, and sedges.

In a representative profile the surface layer is about 3 inches of black muck over about 3 inches of very dark grayish brown loam. The subsoil is grayish brown friable loam about 18 inches thick and is mottled in the lower part. The substratum is mottled, grayish brown, friable loam. It is underlain by dolomite bedrock at a depth of about 32 inches.

The available water capacity is low, and permeability is moderate. These soils are seasonally saturated at a depth of less than 1 foot unless they are drained. If the soils are not drained, the depth of the root zone is limited by the water table. Natural fertility is medium, and the organic-matter content of the surface layer is moderate.

If drained, most areas of these soils are used for pasture or for general farm crops grown in the county. Undrained areas provide good wetland wildlife habitat. Some areas are used for unimproved pasture.

Representative profile of Bonduel Wet Variant loam in an undrained and uncultivated area, 1,200 feet west and 240 feet south of the northeast corner of the NW¼ sec. 6, T. 30 N., R. 28 E.:

Oa1—0 to 3 inches; black (N 2/0) rubbed and pressed sapric material; about 20 percent fibers, less than 10 percent rubbed; weak fine and medium subangular blocky structure; very friable; primarily herbaceous fibers; many roots; neutral; abrupt smooth boundary.

A1—3 to 6 inches; very dark grayish brown (10YR 3/2) loam; weak medium subangular blocky structure; friable; many roots; mildly alkaline; abrupt smooth boundary.

B21—6 to 17 inches; grayish brown (2.5Y 5/2) loam; weak medium subangular blocky structure; friable; few roots; mildly alkaline; clear wavy boundary.

B22g—17 to 24 inches; grayish brown (10YR 5/2) loam; common fine prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; mildly alkaline; clear wavy boundary.

C—24 to 32 inches; grayish brown (10YR 5/2) loam; common fine prominent yellowish brown (10YR 5/6) mottles; massive; friable; strongly effervescent; mildly alkaline; abrupt wavy boundary.

R—32 inches; light gray (10YR 7/2) consolidated dolomite bedrock.

The solum is 16 to 30 inches thick and is neutral or mildly alkaline. Where present, the C horizon is generally mildly alkaline but is neutral in some pedons. Depth to dolomite bedrock is 20 to 40 inches. In cultivated areas, the Oa1 and A1 horizons are mixed in plowing. The B and C horizons are commonly loam. In some places, the C horizon is absent.

Bonduel Wet Variant soils are near Angelica, Bonduel, and Duel Variant soils. They are wetter than Bonduel. They are underlain by dolomite bedrock, whereas Angelica soils are not. Bonduel Wet Variant soils have less sand throughout the profile than Duel Variant soils.

Bp—Bonduel Wet Variant loam. This nearly level soil is in depressions on glacial till plains where dolomite bedrock is at a depth of 20 to 40 inches. Slopes are 0 to 2 percent. Most areas are irregular in shape and are 5 to 20 acres in size.

Included with this soil in mapping are small areas of Bonduel and Namur Variant soils. Also included are small areas of soils that have a silt loam surface layer and areas of soils in which dolomite bedrock is at a depth of less than 20 inches or more than 40 inches.

Runoff is slow. The hazard of erosion is slight. Wetness is the main limitation of this soil. This soil receives runoff from adjoining areas and is likely to be ponded during wet seasons and after heavy rains. Surface drainage removes excess water rapidly. The underlying dolomite bedrock limits the use of deep ditches and tile drains.

If drained, this soil is moderately well suited to corn, small grain, legumes such as red clover, and pasture. Some truck crops are also grown. Undrained areas are used for unimproved pasture, but are better suited to wetland wildlife habitat than to most other uses. Capability unit IIw–3; woodland suitability subclass 4w.

Boyer series

The Boyer series consists of well drained, gently sloping to moderately steep soils on outwash plains and morainic ridges. The native vegetation is red oak and sugar maple.

In a representative profile the surface layer is very dark grayish brown loamy sand about 4 inches thick. The subsurface layer is yellowish brown loamy sand about 13 inches thick. The subsoil is about 16 inches thick; it is brown, friable fine sandy loam in the upper part and dark brown, friable sandy loam in the lower part. The substratum, to a depth of about 38 inches, is brown sand and gravel. Below this, to a depth of about 60 inches, it is yellowish brown fine and medium sand.

The available water capacity is low. Permeability is moderately rapid in the subsoil and rapid in the substratum. These soils are seasonally saturated at a depth of more than 6 feet. The depth of the root zone is limited by sand and gravel. Natural fertility and the organic-matter content of the surface layer are low.

Most gently sloping and sloping areas of these soils are used for all farm crops commonly grown in the county. Most moderately steep areas are used for hay, pasture, woodland, or wildlife habitat. These soils are a good source of sand and gravel.

Representative profile of Boyer loamy sand, 2 to 6 percent slopes, in a wooded area, 440 feet north and 100 feet west of the southeast corner of the NE¼ sec. 27, T. 26 N., R. 23 E.:

A1—0 to 4 inches; very dark grayish brown (10YR 3/2) loamy sand; weak fine granular structure; very friable; many fine roots; slightly acid; clear smooth boundary.

A2—4 to 17 inches; yellowish brown (10YR 5/4) loamy sand; very weak medium granular structure; very friable; common fine roots; medium acid; clear wavy boundary.

B21t—17 to 23 inches; brown (7.5YR 4/4) fine sandy loam; weak medium subangular

blocky structure; friable; clay bridging of sand grains; few fine roots; less than 10 percent gravel; neutral; clear wavy boundary.

B22t—23 to 33 inches; dark brown (7.5YR 4/4) sandy loam; weak medium subangular blocky structure; friable; thin clay films in pores; few fine roots; less than 10 percent gravel; mildly alkaline; abrupt wavy boundary.

IIC1—33 to 38 inches; brown (10YR 5/3) sand and gravel; single grained; loose; 40 percent gravel; strongly effervescent; mildly alkaline.

IIC2—38 to 60 inches; yellowish brown (10YR 5/4) fine and medium sand; single grained; loose; less than 10 percent gravel; effervescent; mildly alkaline.

The solum is 24 to 40 inches thick. It is medium acid to neutral in the upper part and neutral or mildly alkaline in the lower part. The C horizon is commonly mildly alkaline but ranges to moderately alkaline in places. The A1 horizon is very dark grayish brown, dark grayish brown, or brown. The A2 horizon is brown or yellowish brown. The Bt horizon is dark brown, brown, strong brown, or reddish brown. It is commonly sandy loam but includes thin subhorizons of loamy sand or sandy clay loam in some pedons. In some places, the lower part of the solum includes ½- to 2-inch-thick layers or bands of yellowish brown fine sand. The C horizon is typically stratified sand and gravel. Some subhorizons have 10 to 50 percent gravel and others have less than 10 percent gravel, by volume.

In Door County, the annual temperature of these soils is a few degrees cooler than the defined range for the series, but this difference does not alter their usefulness or behavior.

Boyer soils are near Casco and Sisson soils. The Bt horizon of Boyer soils has less clay and more sand than similar horizons of Casco and Sisson soils.

BrB—Boyer loamy sand, 2 to 6 percent slopes. This gently sloping soil is on sandy outwash plains. Most areas are irregular in shape and are 5 to 60 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Manistee, Rousseau, and Sisson soils. Also included are areas of sloping Boyer loamy sand. In a few places the subsoil extends below a depth of 40 inches.

Runoff is slow. The hazard of erosion is moderate. Droughtiness is the main limitation of this soil.

Most areas of this soil are used for corn, small grain, legumes, and pasture. Truck crops are also grown. Management practices such as protection from water erosion and soil blowing and use of green manure crops and barnyard manure are necessary for dependable crop production. Crop yields during most seasons are limited by low available water capacity. If properly managed, this soil is moderately well suited to all crops commonly grown in the county. Capability unit IIIs–4; woodland suitability subclass 3o.

BrC—Boyer loamy sand, 6 to 12 percent slopes. This sloping soil is on sandy outwash plains. Most areas are irregular in shape and are 10 to 80 acres in size.

This soil has a profile similar to the one described as representative of the series, but it has a thinner surface layer and subsoil. This soil also is more susceptible to erosion, more droughty, and generally produces lower yields than the representative soil.

Included with this soil in mapping are small areas of Manistee, Rousseau, and Sisson soils. Also included are small areas of gently sloping and moderately steep Boyer loamy sand. In a few places the subsoil extends below a depth of 40 inches.

Runoff is medium. The hazard of erosion is moderate, and it is the main limitation of this soil.

Most areas of this soil are used for corn, small grain, legumes, and pasture. Some areas remain in woodland. Management practices such as protection from erosion and soil blowing and use of green manure crops and barnyard manure are necessary for dependable crop production. Crop yields during most seasons are limited by low available water capacity. If properly managed, this soil is moderately well suited to all crops commonly grown in the county. Capability unit IIIe–7; woodland suitability subclass 3o.

BrD—Boyer loamy sand, 12 to 20 percent slopes. This moderately steep soil is on morainic ridges. Most areas are irregular in shape and are 10 to 80 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer and subsoil are thinner. This soil is more droughty than the representative soil. The steeper slopes make this soil more susceptible to erosion and limit the use of most farm implements.

Included with this soil in mapping are small areas of Rousseau soils. Also included are small areas of eroded soils and areas of soils that have a sandy loam surface layer.

Runoff is medium. The hazard of erosion is severe, and it is the main limitation of the soil.

Most areas of this soil are used for permanent pasture, unimproved pasture, native woodland, or wildlife habitat. Management practices such as erosion control and use of green manure crops and barnyard manure are necessary for dependable crop production. This soil is poorly suited to farm crops commonly grown in the county. Crop yields during most seasons are limited by low available water capacity. Sand and gravel pits are common on this soil. Capability unit IVe–7; woodland suitability subclass 3r.

Carbondale series

The Carbondale series consists of very poorly drained, nearly level, organic soils in old glacial lake basins and depressions in stream valleys. The native vegetation is northern white-cedar, balsam fir, white ash, white birch, and tag alder.

In a representative profile the upper 8 inches is black muck that contains less than 10 percent recognizable plant fibers if undisturbed. The next 16 inches is black mucky peat that contains 35 to 40 percent recognizable plant fibers if undisturbed. The lower part of the profile to a depth of 60 inches is black muck that contains less than 10 percent recognizable plant fibers if undisturbed.

The available water capacity is very high, and

permeability is moderately rapid. Unless they are drained, these soils are saturated at a depth of less than 1 foot. If the soils are not drained, the depth of the root zone is limited by the water table. Natural fertility is low, and the organic-matter content of the surface layer is very high. Because of restricted air drainage, these soils have a severe frost hazard.

If drained, areas of these soils are used for most general farm crops commonly grown in the county. Undrained areas provide good wetland wildlife habitat. A few areas are used for unimproved pasture.

Representative profile of Carbondale muck in a wooded area, 100 feet east and 100 feet north of the southwest corner of sec. 36, T. 26 N., R. 24 E.:

Oa1—0 to 8 inches; black (10YR 2/1) broken face and rubbed sapric material; less than 10 percent fibers, less than 5 percent rubbed; moderate fine and medium subangular blocky structure; very friable; brown (10YR 5/3) with sodium pyrophosphate; primarily herbaceous fibers; neutral; clear smooth boundary.

Oe1—8 to 24 inches; black (10YR 2/1) broken face and rubbed hemic material; about 35 to 40 percent fibers, about 10 to 15 percent rubbed; massive; friable; very pale brown (10YR 7/3) with sodium pyrophosphate; 65 percent herbaceous fibers; neutral; abrupt smooth boundary.

Oa2—24 to 48 inches; black (10YR 2/1) broken face and rubbed sapric material; about 20 percent fibers, less than 10 percent rubbed; moderate medium granular structure; very friable; very pale brown (10YR 7/4) with sodium pyrophosphate; primarily herbaceous fibers; neutral; clear smooth boundary.

Oa3—48 to 60 inches; black (10YR 2/1) broken face and rubbed sapric material; less than 10 percent fibers; less than 5 percent rubbed; moderate medium granular structure; very friable; light yellowish brown (10YR 6/4) with sodium pyrophosphate; primarily herbaceous fibers; neutral.

The surface and subsurface tiers are commonly slightly acid or neutral, but range to medium acid to mildly alkaline in some pedons. The organic deposits are 51 to 84 inches thick. The range in characteristics is generally in the degree of decomposition and color of the organic material. Thin layers of fibric and less commonly limnic (sedimentary peat) material are in the second and third tiers in some pedons. Wood fragments as much as 2 inches in diameter also are in some places.

Carbondale soils are near the Cathro, Markey, Rondeau, and Suamico soils. They have a thicker organic layer than those soils.

Ca—Carbondale muck. This nearly level soil is in old glacial lake basins and depressions in stream valleys. Slopes are 0 to 2 percent. Most areas are irregular in shape and are 5 to 500 acres in size.

Included with this soil in mapping are small areas of Cathro, Markey, and Suamico soils. Also included are small seep areas of gently sloping soils.

Runoff is very slow. The hazard of erosion is slight; however, large drained areas are susceptible to subsidence and soil blowing. Wetness is the main limitation of this soil. This soil is likely to be ponded during wet seasons and after heavy rains. Surface drainage removes excess water rapidly. Both deep ditches and subsurface drainage remove internal water if outlets are available.

Even if drained, this soil is poorly suited to crops commonly grown in the county because of the frost hazard. Undrained areas are used for unimproved pasture, but are better suited to wetland wildlife habitat than to most other uses. Capability unit IVw–9; woodland suitability subclass 3w.

Casco series

The Casco series consists of well drained, gently sloping and sloping soils on outwash plains and morainic ridges. The native vegetation is sugar maple and red oak.

In a representative profile the surface layer is very dark grayish brown sandy loam about 4 inches thick. The subsurface layer is brown sandy loam about 5 inches thick. The subsoil is about 9 inches thick; it is dark brown, firm sandy clay loam in the upper part; and brown, very friable gravelly loam in the lower part. The substratum is yellowish brown, loose gravelly sand to a depth of about 60 inches.

The available water capacity is low. Permeability is moderate in the subsoil and very rapid in the substratum. These soils are seasonally saturated at a depth of more than 6 feet. The depth of the root zone is limited by the sand and gravel substratum. Natural fertility is medium, and the organic-matter content of the surface layer is low.

Most areas of these soils are used for all farm crops commonly grown in the county. Casco soils are a good source of sand and gravel.

Representative profile of Casco sandy loam, 2 to 6 percent slopes, in a wooded area, 80 feet east and 700 feet south of the northwest corner of sec. 36, T. 26 N., R. 23 E.:

A1—0 to 4 inches; very dark grayish brown (10YR 3/2) sandy loam; weak medium subangular blocky structure; very friable; many roots; mildly alkaline; clear wavy boundary.

A2—4 to 9 inches; brown (10YR 5/3) sandy loam; weak medium platy structure; very friable; many roots; mildly alkaline; clear irregular boundary.

B2t—9 to 15 inches; dark brown (7.5YR 4/4) sandy clay loam; moderate medium and fine subangular blocky structure; firm; common roots; thin patchy dark brown (7.5YR 3/2) clay films on ped faces and in root channels; mildly alkaline; clear wavy boundary.

B3—15 to 18 inches; brown (7.5YR 4/4) gravelly loam; weak medium subangular blocky structure; very friable; mildly alkaline; abrupt wavy boundary.

C—18 to 60 inches; yellowish brown (10YR 5/4) gravelly sand; single grained; loose;

more than 35 percent coarse fragments; strongly effervescent; mildly alkaline.

The solum is 10 to 24 inches thick and is commonly neutral or mildly alkaline. The C horizon is mildly alkaline or moderately alkaline. In undisturbed areas are a thin, dark colored A1 horizon and a dark grayish brown or brown A2 horizon. The Ap horizon, in cultivated areas, is dark grayish brown or dark brown sandy loam. The B2t horizon is dark brown, brown, or reddish brown. It is sandy clay loam, clay loam, or heavy loam. The C horizon has strata of poorly sorted to well sorted calcareous sand and gravel. Coarse fragments make up more than 35 percent, by volume.

In Door County, annual temperature of these soils is a few degrees cooler than the defined range for the series, but this difference does not alter their usefulness and behavior.

Casco soils are near Alpena, Boyer, and Kiva soils. They have a higher clay content in the B horizon than those soils. The C horizon of Casco soils is mainly sand and gravel, whereas the C horizon of the Boyer soils is mainly sand.

CcB—Casco sandy loam, 2 to 6 percent slopes. This gently sloping soil is on outwash plains and low morainic ridges. Most areas are elongated and are 10 to 60 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Boyer soils. Also included are small areas of nearly level, eroded, and sloping Casco sandy loam and small areas of soils that have a loam surface layer.

Runoff is medium. The hazard of erosion is moderate, and it is the main limitation of this soil.

Some areas of this soil are used for corn, small grain, legumes, and pasture. Crop yields are limited in most years by low available water capacity. Some areas remain in native woodland. Management practices such as protection from water erosion and the use of green manure crops are necessary for sustained crop yields. If properly managed, this soil is moderately well suited to row crops commonly grown in the county. Sand and gravel pits are common on this soil. Capability unit IIIe–3; woodland suitability subclass 3d.

CcC2—Casco sandy loam, 6 to 12 percent slopes, eroded. This sloping soil is on outwash morainic ridges. Most areas are elongated and are 10 to 60 acres in size.

This soil has a profile similar to the one described as representative of the series, but it is more eroded and has a thinner surface layer. This soil is also more susceptible to erosion, more droughty, and generally produces lower yields than the representative soil.

Included with this soil in mapping are small areas of Boyer soils. Also included are small areas of gently sloping and slightly eroded Casco sandy loam and areas of soils that have a loam surface layer.

Runoff is medium. The hazard of erosion is moderate, and it is the main limitation of this soil.

Some areas of this soil are used for corn, small grain, legumes, and pasture. Crop yields are limited in most years by low available water capacity. Some areas also remain in native woodland. Management practices such as protection from water erosion and the use of green manure crops are necessary for sustained crop yields. Even if properly managed, this soil is poorly suited to row crops commonly grown in the county. Sand and gravel pits are common on this soil. Capability unit IVe–3; woodland suitability subclass 3d.

Cathro series

The Cathro series consists of very poorly drained, nearly level, organic soils in old glacial lake basins and depressions. The native vegetation is northern white-cedar, white ash, white birch, tag alder, and redosier dogwood.

In a representative profile the upper 30 inches is black muck that contains 20 to 30 percent recognizable plant fibers if undisturbed. The upper 3 inches of the substratum is gray, very firm clay loam. The lower part of the substratum is brown, firm loam to a depth of about 60 inches. There are mottles in the substratum.

The available water capacity is very high. Permeability is moderately rapid in the organic layers and moderate in the substratum. These soils are saturated at a depth of less than 1 foot unless they are drained. If undrained, the depth of the root zone is limited by the water table. Natural fertility is low, and the organic-matter content of the surface layer is very high.

If drained, areas of these soils are used for improved pasture.

Representative profile of Cathro muck in a wooded area, 800 feet north and 440 feet east of the southwest corner of sec. 35, T. 26 N., R. 25 E.:

Oa1—0 to 15 inches; black (10YR 2/1) broken face and rubbed sapric material; less than 20 percent fibers, less than 10 percent rubbed; weak medium subangular blocky structure parting to moderate and fine medium granular; primarily herbaceous fibers; neutral; clear wavy boundary.

Oa2—15 to 27 inches; black (10YR 2/1) broken face and rubbed sapric material; less than 30 percent fibers, less than 10 percent rubbed; weak medium platy structure parting to moderate fine and medium granular; primarily herbaceous fibers; neutral; abrupt wavy boundary.

Oa3—27 to 30 inches; black (10YR 2/1) broken face and rubbed sapric material; less than 30 percent fibers, less than 10 percent rubbed; massive; primarily herbaceous fibers; abundant sand grains; neutral; abrupt wavy boundary.

IIC1g—30 to 33 inches; gray (10YR 5/1) light clay loam; common medium distinct yellowish brown (10YR 5/4) mottles; massive; very firm, sticky; strongly effervescent; mildly alkaline; clear wavy boundary.

IIC2—33 to 60 inches; brown (10YR 5/3) loam; common medium distinct gray (10YR 5/1) mottles; massive; firm, slightly sticky; strongly effervescent; mildy alkaline.

The organic horizons are commonly neutral and are 16 to 51 inches thick. In some pedons, the reaction is medium acid to mildly alkaline. The organic material ranges in degree of decomposition and is commonly very dark gray or black. The IIC horizon ranges from

neutral to moderately alkaline. It is mainly loam, silt loam, or sandy loam, but in places it includes thin layers of fine sand, silty clay loam, or clay loam.

Cathro soils are near Carbondale and Suamico soils. They have a thinner organic layer than Carbondale soils and they do not have the clayey C horizon that Suamico soils have.

Cm—Cathro muck. This nearly level soil is in old glacial lake basins and depressions. Slopes are 0 to 2 percent. Most areas are irregular in shape and are 5 to 100 acres in size.

Included with this soil in mapping are small areas of Carbondale and Suamico soils. Also included are small seep areas of gently sloping soils.

Runoff is very slow. The hazard of erosion is slight. Wetness is the main limitation of this soil. This soil is likely to be ponded during wet seasons and after heavy rains. Surface drainage removes excess water rapidly. Deep ditches and subsurface drainage remove internal water if outlets are available.

Even if drained, this soil is poorly suited to crops commonly grown in the county because of the frost hazard. Undrained areas are used for unimproved pasture, but are better suited to wetland wildlife habitat than to most other uses. Capability unit IVw–7; woodland suitability subclass 3w.

Chippeny series

The Chippeny series consists of very poorly drained, nearly level, organic soils in shallow old glacial lake basins. The native vegetation is northern white cedar, balsam fir, white ash, white birch, and tag alder.

In a representative profile the upper 10 inches is dark reddish brown muck that contains about 20 percent recognizable plant fibers if undisturbed. The next 17 inches is black muck that contains about 30 percent recognizable plant fibers if undisturbed. The upper 6 inches of the substratum is light yellowish brown gravel and stones. The next 5 inches of the substratum is pale brown loamy fine sand. Dolomite bedrock is at a depth of about 38 inches.

The available water capacity is high. Permeability is moderately slow to moderate. These soils are saturated at a depth of less than 1 foot unless they are drained. If the soils are not drained, the depth of the root zone is limited by the water table. Natural fertility is low, and the organic-matter content of the surface layer is very high.

Most areas of these soils are undrained and remain in native vegetation. Undrained areas provide very good wetland wildlife habitat. A few areas are used for unimproved pasture.

Representative profile of Chippeny muck in a wooded area, 1,400 feet west and 100 feet south of the center of sec. 29, T. 29, N., R. 26 E.:

Oa1—0 to 10 inches; dark reddish brown (5YR 2/2) broken face and rubbed sapric material; about 20 percent fibers, less than 5 percent rubbed; weak fine granular structure; very friable; mixed herbaceous and woody fibers; neutral; gradual wavy boundary.

Oa2—10 to 27 inches; black (5YR 2/1) broken face and rubbed sapric material; about 30 percent fibers, less than 10 percent rubbed; weak medium subangular blocky structure parting to weak fine granular; very friable; mixed herbaceous and woody fibers; mildly alkaline; clear wavy boundary.

IIC1—27 to 33 inches; light yellowish brown (10YR 6/4) dolomite gravel and stones, ½ to 10 inches in diameter; some coatings from the overlying organic horizons; abrupt smooth boundary.

IIC2—33 to 38 inches; pale brown (10YR 6/3) loamy fine sand; massive; nonsticky; some dolomite fragments and small snail shell fragments present; strongly effervescent; mildly alkaline.

R—38 inches; light gray (10YR 7/2) dolomite bedrock.

The organic horizons are commonly neutral to mildly alkaline but range to medium acid in some pedons. The depth to dolomite bedrock is 24 to 51 inches. Woody fragments range from ½ to 3 inches in diameter and occur at random throughout the organic material. They occupy less than 15 percent of the volume. The IIC horizon is neutral to moderately alkaline and ranges from very dark gray to light yellowish brown. It is commonly loamy fine sand but ranges to silty clay loam in some pedons. The content of coarse fragments in the IIC horizon is extremely variable.

Chippeny soils are near Bonduel and Namur soils. They are wetter and have a 24- to 51-inch-thick organic layer which the Bonduel and Namur soils do not have. The depth to dolomite bedrock also is greater than in Namur soils.

Cp—Chippeny muck. This nearly level soil is in old glacial lake basins. Slopes are 0 to 2 percent. Most areas are elongated and are 10 to 60 acres in size.

Included with this soil in mapping are small areas of Bonduel and Namur soils.

Runoff is very slow. The hazard of erosion is slight. Wetness is the main limitation of this soil. This soil is likely to be ponded during wet seasons and after heavy rains. Surface drainage removes excess water rapidly. The underlying dolomite bedrock limits the use of deep ditches and subsurface drainage.

Even if drained the soil is poorly suited to crops commonly grown in the county because of the frost hazard. Undrained areas are better suited to wetland wildlife habitat than to most other uses. Capability unit VIIs–10; woodland suitability subclass 3w.

Deford series

The Deford series consists of poorly drained, nearly level soils in depressions on outwash plains and in old glacial lake basins. The native vegetation is American elm, white ash, and northern white–cedar.

In a representative profile the surface layer is black loamy fine sand about 4 inches thick. The substratum is pinkish gray and light brownish gray, loose fine sand to a depth of about 60 inches.

The available water capacity is low, and permeability is rapid. These soils are seasonally saturated at a depth of less than 1 foot unless they are drained. If undrained, the depth of the root zone is limited by the water table.

Natural fertility is low, and the organic-matter content of the surface layer is high.

If drained, these soils are used for most general farm crops commonly grown in the county. Undrained areas provide good wetland wildlife habitat. A few areas are used for unimproved pasture.

Representative profile of Deford loamy fine sand in a wooded area, 760 feet east and 600 feet north of the southwest corner of the SE¼ sec. 17, T. 30 N., R. 28 E.:

A1—0 to 4 inches; black (10YR 2/1) loamy fine sand; very weak fine granular structure; very friable; slightly acid; abrupt wavy boundary.

C1—4 to 21 inches; pinkish gray (7.5YR 6/2) fine sand; single grained; loose; neutral; clear wavy boundary.

C2—21 to 60 inches; light brownish gray (10YR 6/2) fine sand; single grained; loose; neutral.

The reaction is commonly slightly acid to mildly alkaline to a depth of 60 inches but ranges from medium acid to moderately alkaline in some pedons. The A horizon is 4 to 8 inches thick. The C horizon is light brownish gray, gray, or pinkish gray. It is commonly fine sand but ranges to very fine sand or loamy fine sand. The content of coarse fragments is less than 5 percent, by volume.

Deford soils are near Markey, Rousseau, and Wainola soils. They are not so poorly drained as Markey soils, and they do not have the thick organic layer of those soils. Deford soils are more poorly drained than Rousseau and Wainola soils.

De—Deford loamy fine sand. This nearly level soil is in depressions of sandy glacial outwash and on lake plains. Slopes are 0 to 2 percent. Most areas are irregular in shape and are 5 to 150 acres in size.

Included with this soil in mapping are small areas of Markey and Wainola soils. Also included are small areas of soils that have a fine sandy loam or muck surface layer.

Runoff is very slow. The hazard of erosion is slight. Wetness is the main limitation of this soil. This soil receives runoff from adjoining areas and is likely to be ponded during wet seasons and after heavy rains. Surface drainage removes excess surface water rapidly. Deep ditches provide internal drainage.

If drained, this soil is used for corn, small grain, red clover, and pasture. Some truck crops are also grown. Even if drained this soil is poorly suited to most of the crops commonly grown in the county because of low available water capacity and frost hazard. Undrained areas are used for unimproved pasture, but are better suited to wetland wildlife habitat than to most other uses. Capability unit IVw–5; woodland suitability subclass 4w.

Duel series

The Duel series consists of well drained, nearly level and gently sloping soils on glacial outwash plains where dolomite bedrock is at a depth of 20 to 40 inches. The native vegetation is sugar maple, aspen, and white birch.

In a representative profile the surface layer is black loamy sand about 2 inches thick. The subsurface layer is grayish brown sand about 1 inch thick. The subsoil is about 13 inches thick; it is reddish brown, very friable sand in the upper part and dark reddish brown, very friable sand in the lower part. The substratum is brown, very friable loamy sand about 12 inches thick. The dolomite bedrock is at a depth of about 28 inches.

The available water capacity is very low, and permeability is rapid. These soils are saturated at a depth of more than 6 feet. The depth of the root zone is limited by the dolomite bedrock. Natural fertility and the organic-matter content of the surface layer are low.

Most areas of these soils are used for farm crops commonly grown in the county. Some areas remain in native woodland.

Representative profile of Duel loamy sand, 1 to 6 percent slopes, in a wooded area, 940 feet south and 200 feet west of the northeast corner of the SE¼ sec. 15, T. 29 N., R. 27 E.:

A1—0 to 2 inches; black (N 2/0) loamy sand; moderate fine and very fine subangular blocky structure; very friable; many roots; slightly acid; clear smooth boundary.

A2—2 to 3 inches; grayish brown (10YR 5/2) sand; weak fine and very fine subangular blocky structure; loose; many roots; slightly acid; clear wavy boundary.

B21ir—3 to 10 inches; reddish brown (5YR 4/4) sand; weak medium subangular blocky structure; very friable; many roots; slightly acid; clear wavy boundary.

B22ir—10 to 16 inches; dark reddish brown (5YR 3/4) sand; weak medium subangular blocky structure; very friable; many roots; few dolomite fragments; neutral; clear smooth boundary.

C—16 to 28 inches; brown (10YR 4/3) loamy sand; weak medium subangular blocky structure; very friable; many roots to 20 inches; ½- to 2-inch diameter dolomite fragments make up 20 percent of the horizon; slightly effervescent; mildly alkaline; abrupt smooth boundary.

R—28 inches; light gray (10YR 7/2) consolidated dolomite bedrock.

The solum is 14 to 35 inches thick. The upper part is commonly slightly acid but ranges to strongly acid in some pedons, and the lower part is commonly slightly acid to neutral but ranges to strongly acid. Content of coarse fragments in the C horizon ranges from 10 to 20 percent, by volume. The depth to dolomite is 20 to 40 inches.

Duel soils are near Duel Variant, Longrie, and Summerville soils. They have a higher sand content than Longrie and Summerville soils. Duel soils are underlain by bedrock at a depth of 20 to 40 inches, whereas Summerville soils are underlain by bedrock at a depth of less than 20 inches. Duel soils are not so wet as Duel Variant soils.

DuB—Duel loamy sand, 1 to 6 percent slopes. This nearly level and gently sloping soil is on glacial outwash plains that are underlain by dolomite bedrock at a depth between 20 and 40 inches. Most areas are irregular in shape and are 5 to 25 acres in size. Bedrock outcrops are in some places.

Included with this soil in mapping are small areas of Duel Variant and Rousseau soils. Also included are small areas of a sloping Duel loamy sand and small areas of soils that have a sandy loam surface layer. In places where this soil is adjacent to Rousseau soils, small areas are underlain by dolomite at a depth of 40 to 60 inches. The lower part of the subsoil and the substratum are mottled in some places.

Runoff is slow. The hazard of erosion is moderate. Droughtiness is the main limitation.

Some areas of this soil are used for corn, small grain, legumes, and pasture. Crop yields during most seasons are limited by the very low available water capacity. Other areas remain in pasture or native woodland. Management practices such as the use of green manure crops and supplemental irrigation are necessary for dependable crop production. Even if properly managed, this soil is poorly suited to crops commonly grown in the county. It is better suited to woodland or wildlife habitat than to most other uses. Capability unit IVs–3; woodland suitability subclass 3s.

Duel Variant

The Duel Variant consists of somewhat poorly drained and poorly drained, nearly level soils on glacial outwash plains where dolomite bedrock is at a depth of 24 to 40 inches. The native vegetation is American elm, sugar maple, white ash, and northern white-cedar.

In a representative profile the surface layer is black sandy loam about 9 inches thick. The upper part of the substratum is light brownish gray, loose sand about 8 inches thick. The lower part of the substratum is light gray, loose sand about 15 inches thick. The underlying dolomite bedrock is at a depth of about 32 inches.

The available water capacity is very low, and permeability is rapid. These soils are seasonally saturated at a depth of less than 3 feet unless they are drained. If the soils are not drained, the depth of the root zone is limited by the water table. Natural fertility is medium, and the organic matter content of the surface layer is moderate.

If drained, most areas of these soils are used for most general farm crops commonly grown in the county. Undrained areas provide good wetland wildlife habitat. Some areas are used for unimproved pasture.

Representative profile of Duel Variant sandy loam in a wooded area, 1,440 feet east and 1,100 feet north of the center of sec. 12, T. 27 N., R. 26 E.:

A1—0 to 9 inches; black (N 2/0) sandy loam; weak medium granular structure; very friable; high organic-matter content; neutral; abrupt wavy boundary.

C1—9 to 17 inches; light brownish gray (10YR 6/2) sand; single grained; loose; mildly alkaline; clear wavy boundary.

C2—17 to 32 inches; light gray (10YR 7/2) sand; single grained; loose; mildly alkaline; abrupt wavy boundary.

R—32 inches; light gray (10YR 7/2) consolidated dolomite bedrock.

The profile is neutral or mildly alkaline throughout. The A1 horizon is 6 to 10 inches thick. In some places, there is a thin organic layer overlying it. The depth to bedrock is 24 to 40 inches.

Duel Variant soils are near Bonduel Wet Variant, Duel, and Summerville soils. They have more sand throughout the profile than Bonduel Wet Variant soils. Duel Variant soils are wetter and are underlain by bedrock at a greater depth than the well drained Summerville soils. They are also wetter than Duel soils.

Dv—Duel Variant sandy loam. This nearly level soil is in depressions on glacial outwash plains where dolomite bedrock is at a depth of 24 to 40 inches. Slopes are 0 to 2 percent. Most areas are irregular in shape and are 5 to 25 acres in size. Dolomite bedrock outcrops are in some places.

Included with this soil in mapping are small areas of Bonduel Wet Variant and Duel soils. Also included are small areas of soils that have a loamy sand surface layer. In places, dolomite bedrock is at a depth of 40 to 60 inches.

Runoff is slow. The hazard of erosion is slight. Wetness is the main limitation. This soil receives runoff from adjoining areas and is likely to be ponded during wet seasons and after heavy rains. Surface drainage removes excess water rapidly. The underlying dolomite bedrock limits the use of deep ditches and tile drains.

This soil is poorly suited to crops commonly grown in the county, even if drained. Undrained areas are used for unimproved pasture, but are better suited to wetland wildlife habitat than to most other uses. Capability unit IVw–5; woodland suitability subclass 4w.

Emmet series

The Emmet series consists of well drained and moderately well drained, nearly level to very steep soils on glacial till plains and ridges. The native vegetation is sugar maple, red oak, American beech, and some white pine.

In a representative profile the surface layer is very dark grayish brown sandy loam about 9 inches thick. The upper 9 inches of the subsoil is brown, very friable loamy sand; the next 6 inches is brown, friable sandy loam that is slightly hard when dry; the next 3 inches is reddish brown, firm, heavy loam; and the lower 7 inches is reddish brown, friable sandy loam. The substratum is light brown, friable sandy loam to a depth of about 60 inches.

The available water capacity is moderate. Permeability is moderate in the subsoil and moderately rapid in the substratum. These soils are seasonally saturated at a depth of 2.5 feet to more than 6 feet. The depth of the root zone is more than 6 feet. Natural fertility and the organic-matter content of the surface layer are low.

Most gently sloping and sloping areas of these soils are used for all farm crops commonly grown in the county. Most moderately steep, steep, and very steep areas are used for hay, pasture, woodland, or wildlife habitat.

Representative profile of Emmet sandy loam, 2 to 6 percent slopes, in a cultivated field, 1,220 feet west and 300 feet north of the southeast corner of the SW¼ sec. 16, T. 28 N., R. 25 E.:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) sandy loam; moderate fine granular structure; very friable; slightly acid; abrupt smooth boundary.

Bir—9 to 18 inches; brown (7.5YR 4/4) loamy

sand; weak fine subangular blocky structure; very friable; slightly acid; gradual wavy boundary.

A2—18 to 24 inches; brown (10YR 5/3) sandy loam; weak medium subangular blocky structure; friable; slightly acid; clear wavy boundary.

B2t—24 to 27 inches; reddish brown (5YR 4/4) heavy loam; moderate medium and coarse subangular blocky structure; firm; neutral; clear wavy boundary.

B3—27 to 34 inches; reddish brown (5YR 5/4) sandy loam; weak coarse subangular blocky structure; friable; neutral; clear irregular boundary.

C—34 to 60 inches; light brown (7.5YR 6/4) sandy loam; weak medium subangular blocky structure; friable; strongly effervescent; mildly alkaline.

The solum is 24 to 40 inches thick and is slightly acid to neutral. The C horizon ranges from mildly alkaline to moderately alkaline. The A1 horizon is very dark gray or very dark grayish brown. In cultivated areas, the Ap horizon is very dark grayish brown or dark grayish brown. Where present, the A2 horizon is sandy loam or loamy sand. It underlies the Bir horizon and is dominantly grayish brown or brown. The Bir horizon is dark brown, brown, or strong brown. It is dominantly loamy sand but ranges to sandy loam. The Bt horizon is dark brown, brown, or dark yellowish brown heavy sandy loam, loam, or sandy clay loam. The C horizon is brown, light brown, or light yellowish brown sandy loam. Coarse fragments in this horizon range from 5 to 15 percent, by volume.

Emmet soils are near Omena soils. They have a thicker solum than Omena soils.

EmA—Emmet sandy loam, 0 to 2 percent slopes. This nearly level soil is on glacial till plains. Most areas are irregular in shape and are 2 to 150 acres in size.

This soil has a profile similar to the one described as representative of the series, but it has a thicker surface layer. This soil also is less susceptible to erosion than the representative soil.

Included with this soil in mapping are small areas of Omena Variant, Longrie, and Solona soils. Also included are small areas of gently sloping Emmet soils.

Runoff is slow. The hazard of erosion is slight. Droughtiness is the main limitation of this soil.

Most areas of this soil are used for corn, small grain, legumes, and pasture. Truck and orchard crops are also grown. Management practices such as the use of green manure crops and barnyard manure are necessary to sustain crop yields. If properly managed, this soil is well suited to all crops, including apples and cherries, that are commonly grown in the county. Capability unit IIs–1; woodland suitability subclass 2o.

EmB—Emmet sandy loam, 2 to 6 percent slopes. This gently sloping soil is on glacial till plains. Most areas are irregular in shape and are 3 to 80 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Omena soils. Also included are small areas of Emmet sandy loam, 6 to 12 percent slopes, and small areas of Emmet soils that have a loam or a loamy sand surface layer.

Runoff is slow. The hazard of erosion is moderate, and it is the main limitation of this soil (fig. 3).

Most areas of this soil are used for corn, small grain, legumes, and pasture. Truck crops and fruit trees are also grown. Management practices such as protection from water erosion and use of green manure crops and barnyard manure are necessary for sustained crop yields. If properly managed, this soil is well suited to all crops, including orchard crops, that are commonly grown in the county. Capability unit IIe–2; woodland suitability subclass 2o.

EmC2—Emmet sandy loam, 6 to 12 percent slopes, eroded. This sloping soil is on glacial till plains. Most areas are irregular in shape and are 3 to 80 acres in size.

This soil has a profile similar to the one described as representative of the series, but it has a thinner surface layer and subsoil. This soil is more susceptible to erosion, is somewhat more droughty, and generally produces lower yields than the representative soil.

Included with this soil in mapping are small areas of Omena soils. Also included are small areas of gently sloping and moderately steep Emmet sandy loams and small areas of soils that have a loam or loamy sand surface layer.

Runoff is medium. The hazard of erosion is moderate, and it is the main limitation of this soil.

Most areas of this soil are used for corn, small grain, legumes, and pasture. Truck crops and fruit trees are also grown. Management practices such as protection from water erosion and the use of green manure crops and barnyard manure are necessary for sustained crop yields. If properly managed, this soil is moderately well suited to row crops commonly grown in the county and moderately well suited to orchard crops. Capability unit IIIe–2; woodland suitability subclass 2o.

EmD2—Emmet sandy loam, 12 to 20 percent slopes, eroded. This moderately steep soil is on glacial till ridges. Most areas are irregular in shape and are 3 to 80 acres in size.

This soil has a profile similar to the one described as representative of the series, but it has a thinner surface layer and subsoil. This soil is more susceptible to erosion, is more droughty, and produces lower yields than gently sloping and sloping Emmet sandy loams. This soil is too steep for the use of most tractor-drawn implements.

Included with this soil in mapping are small areas of Omena soils. Also included are small areas of sloping Emmet sandy loam and small areas of soils that have a loamy sand surface layer.

Runoff is medium. The hazard of erosion is severe, and it is the main limitation of this soil.

Most areas of this soil are used for permanent hay, unimproved pasture, native woodland, or wildlife habitat. Management practices such as erosion control and use of green manure crops and barnyard manure are necessary for dependable crop production. This soil is poorly suited to row crops commonly grown in the county. Capability unit IVe–2; woodland suitability subclass 2r.

EmE—Emmet sandy loam, 20 to 35 percent slopes. This steep and very steep soil is on glacial till ridges. Most areas are elongated in shape and are 5 to 40 acres in size.

Figure 3.—**Typical area of Emmet soils. In the background, contour strips have been established to control erosion.**

This soil has a profile similar to the one described as representative of the series, but it has a thinner surface layer. This soil is more susceptible to erosion and is more droughty than gently sloping, sloping, and moderately steep Emmet sandy loams. This soil is too steep for use of tractor-drawn implements.

Included with this soil in mapping are small areas of Omena soils. Also included are small areas of soils that have a loamy surface layer and some areas of soils that have slopes of more than 35 percent.

Runoff is rapid. The hazard of erosion is very severe, and it is the main limitation of this soil.

This soil is used for unimproved pasture, native woodland, or wildlife habitat. Management practices such as erosion control and use of green manure crops and barnyard manure are necessary for dependable crop production. This soil is generally unsuited to crops commonly grown in the county. Capability unit VIe–2; woodland suitability subclass 2r.

Fabius series

The Fabius series consists of somewhat poorly drained, nearly level soils on outwash plains. The native vegetation is American elm, white oak, and red-osier dogwood.

In a representative profile the surface layer is very dark gray silt loam about 5 inches thick. The subsurface layer is mottled, brown loam about 2 inches thick. The subsoil is about 12 inches thick and is mottled; it is dark yellowish brown, friable sandy clay loam in the upper part and dark brown, friable heavy sandy loam in the lower part. The substratum, to a depth of about 60 inches, is brown gravelly sand.

The available water capacity is low. Permeability is moderate in the subsoil and rapid in the substratum. These soils are seasonally saturated at a depth of 1.5 to 2.0 feet unless they are drained. If the soils are not drained, the depth of the root zone is limited by the water table. Natural fertility is medium, and the organic-matter content of the surface layer is moderate.

If drained, most areas of these soils are used for pasture or for general farm crops commonly grown in the county. Undrained areas provide good wetland wildlife habitat. A few areas are used for unimproved pasture.

Representative profile of Fabius silt loam in an uncultivated area, 80 feet west and 90 feet north of the southeast corner of the SW¼ sec. 33, T. 28 N., R. 25 E.:

A1—0 to 5 inches; very dark gray (10YR 3/1) silt loam; moderate medium granular structure; very friable; many roots; neutral; clear smooth boundary.

A2—5 to 7 inches; brown (10YR 4/3) loam; common fine prominent yellowish brown (10YR 5/6) and common fine faint grayish brown (10YR 5/2) mottles; weak coarse granular structure; very friable; many roots; many earthworm casts; neutral; clear irregular boundary.

B21t—7 to 15 inches; dark yellowish brown (10YR 3/4) sandy clay loam; common fine distinct yellowish brown (10YR 5/6) and many medium distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; friable; many roots to 9 inches; few thin clay films on ped faces and in pores; neutral; clear irregular boundary.

B22t—15 to 19 inches; dark brown (10YR 3/3) heavy sandy loam; many medium prominent yellowish brown (10YR 5/6) and many medium distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; friable; brownish yellow (10YR 6/6) weathered dolomite fragments present; few thin clay films on ped faces and in pores; mildly alkaline; clear wavy boundary.

IIC—19 to 60 inches; brown (7.5YR 5/4) gravelly sand; variegated colors throughout; single grained; loose; strongly effervescent; moderately alkaline.

The solum is 10 to 24 inches thick. It is commonly neutral but ranges from medium acid to mildly alkaline in some pedons. The depth to mottling is 5 to 12 inches. In cultivated areas, the Ap horizon is very dark grayish brown, very dark gray, or very dark brown and is 7 or more inches thick. The B horizon is sandy loam or sandy clay loam. The C horizon consists of strata of poorly sorted to well sorted, calcareous sand and gravel. It has more than 35 percent coarse fragments, by volume.

In Door County these soils have colors that are lower in value in the B horizon and are a few degrees cooler than the defined range for the series. These differences do not alter their usefulness and behavior.

Fabius soils are near the well drained Kiva soils. They have more clay in the B horizon than Kiva soils.

Fa—Fabius silt loam. This nearly level soil is on outwash plains. Slopes are 0 to 2 percent. Most areas are irregular in shape and are 5 to 50 acres in size.

Included with this soil in mapping are small areas of Casco and Kiva soils. Also included are a few small areas of Fabius soils that have a loam or gravelly loam surface layer.

Runoff is slow. The hazard of erosion is slight. Wetness is the main limitation of this soil. This soil receives runoff from adjoining areas and is likely to be ponded during wet seasons and after heavy rains. Surface drainage removes excess surface water rapidly. Deep ditches provide internal drainage.

If drained, this soil is suited to corn, small grain, legumes such as red clover, and pasture. Undrained areas are used for unimproved pasture. Undrained areas provide good wetland wildlife habitat. Capability unit IIIw–5; woodland suitability subclass 3o.

Fluvaquents

Fu—Fluvaquents. The Fluvaquents consist of soils that formed in light and dark colored sediment that was deposited by streams on flood plains and the bottoms of narrow valleys. Slopes are 0 to 2 percent. These soils are subject to frequent flooding and to deposition of fresh sediment when floodwaters recede. The sediment is stratified in most places and ranges from gravelly sand to clay loam.

These soils are generally poorly drained, but in some places are small areas of well drained to somewhat poorly drained soils. Some small areas at slightly higher elevations are subject to periodic flooding.

Fluvaquents are better suited to woodland, wildlife habitat, and limited pasture than to most other uses. Because of the flooding hazard, they are poorly suited to crops. Capability unit Vw–14; woodland suitability subclass 4w.

Gravel pits

Gp—Gravel pits. Gravel pits are those areas where sand and gravel have been removed to a depth of several feet for use in highway construction and other engineering projects. Areas are 2 to 80 acres in size and are within or near areas of Alpena, Casco, and Kiva soils.

Gravel pits are scattered throughout the county, and many are still in use. They are better suited to recreational uses or to wildlife habitat than to most other uses. Not placed in a capability unit or a woodland suitability subclass.

Kewaunee series

The Kewaunee series consists of well drained and moderately well drained, nearly level to moderately steep soils on glacial till plains. The native vegetation is mostly red oak and sugar maple.

In a representative profile the surface layer is dark yellowish brown silt loam about 8 inches thick. The subsurface layer is brown silt loam about 4 inches thick. The subsoil is about 16 inches thick; it is reddish brown and yellowish brown, firm heavy clay loam in the upper part and reddish brown, very firm silty clay in the lower part. The substratum is reddish brown, very firm silty clay to a depth of about 60 inches.

The available water capacity is moderate, and permeability is moderately slow. Some areas of these soils are seasonally ponded for short periods. The depth of the root zone is more than 6 feet. Natural fertility is high, and the organic-matter content of the surface layer is moderate.

Most nearly level, gently sloping, and sloping areas of these soils are used for all farm crops commonly grown in the county. Most moderately steep areas are used for hay, pasture, or woodland.

Representative profile of Kewaunee silt loam, 2 to 6 percent slopes, in a cultivated field, 540 feet east and 480 feet north of the southwest corner of the SE¼ sec. 32, T. 26 N., R. 23 E.:

Ap—0 to 8 inches; dark yellowish brown (10YR 3/4) silt loam; light brownish gray (10YR 6/2) dry; moderate fine subangular blocky structure; friable; many roots; neutral; abrupt smooth boundary.

A2—8 to 12 inches; brown (7.5YR 5/4) silt loam; moderate medium subangular blocky structure; friable; many roots; neutral; clear irregular boundary.

B1—12 to 16 inches; reddish brown (5YR 4/4) and yellowish brown (7.5YR 5/4) heavy clay loam; moderate medium subangular blocky structure; firm; clean sand grains on ped faces; common roots; slightly acid; clear irregular boundary.

B2t—16 to 25 inches; reddish brown (5YR 4/4) silty clay; moderate medium angular and subangular blocky structure; very firm; thin patchy clay films on ped faces; common roots; slightly acid; clear wavy boundary.

B3—25 to 28 inches; reddish brown (2.5YR 4/4) silty clay; moderate medium subangular blocky structure; very firm; common roots; neutral; clear wavy boundary.

C—28 to 60 inches; reddish brown (5YR 4/4) silty clay; moderate medium subangular blocky structure; very firm; strongly effervescent; mildly alkaline.

The solum is commonly slightly acid to neutral but ranges from medium acid to mildly alkaline in some pedons. The C horizon is commonly mildly alkaline but ranges to moderately alkaline in some places. The Ap horizon is very dark grayish brown, dark grayish brown, dark yellowish brown, or brown. The A2 horizon is dark grayish brown, brown, or yellowish brown. The B horizon is reddish brown, yellowish red, or red. It is commonly clay or silty clay but ranges to heavy clay loam or silty clay loam in some pedons. The C horizon is similar in color to the B horizon. It is commonly silty clay or clay but ranges to silty clay loam. Content of coarse fragments is less than 10 percent, by volume.

In Door County, the annual temperature of these soils is a few degrees cooler than the defined range for the series, but this difference does not alter their usefulness and behavior.

Kewaunee soils are near Kolberg, Manawa, Manistee, and Poygan soils. They are better drained than the somewhat poorly drained Manawa soils and the poorly drained Poygan soils. Kewaunee soils do not have the dolomite bedrock that underlies Kolberg soils at a depth of 20 to 40 inches, and they do not have the sandy A and B horizons of Manistee soils.

KhA—Kewaunee silt loam, 0 to 2 percent slopes. This nearly level soil is on glacial till plains. Most areas are irregular in shape and are 10 to 100 acres in size.

This soil has a profile similar to the one described as representative of the series, but it has a thicker surface layer. This soil also is less susceptible to erosion than the representative soil.

Included with this soil in mapping are small areas of Kolberg and Manawa soils. Also included are small areas of gently sloping and sloping Kewaunee silt loam and small areas of soils in which dolomite bedrock is at a depth of 40 to 60 inches.

Runoff is slow. The hazard of erosion is slight. The hazard of brief ponding during wet periods is the main limitation of this soil. Because the subsoil is clayey, rainwater does not readily enter this soil and the surface layer becomes saturated. This soil has poor tilth where the surface layer has been removed. It dries slowly in spring and is likely to be ponded after heavy rains. Surface or subsurface drainage is used to remove excess water rapidly.

Most areas of this soil are used for corn, small grain, legumes, and pasture. Truck crops are also grown. Management practices such as the use of green manure crops and barnyard manure are necessary for sustained crop yields. If properly managed, this soil is well suited to all crops commonly grown in the county. Capability unit IIs–8; woodland suitability subclass 2c.

KhB—Kewaunee silt loam, 2 to 6 percent slopes. This gently sloping soil is on glacial till plains. Most areas are irregular in shape and are 10 to 200 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Kolberg, Manawa, and Omro soils. Also included are areas of nearly level and sloping Kewaunee silt loams; small areas of soils in which dolomite bedrock or loamy material are at a depth of 40 to 60 inches; and areas of gently sloping, eroded Kewaunee silt loam that has a reddish surface layer when plowed.

Runoff is medium. The hazard of erosion is moderate, and it is the main limitation of this soil. Good tilth is more difficult to maintain on eroded areas.

Most areas of this soil are used for corn, small grain, legumes, and pasture. Truck crops are also grown. Management practices such as erosion control and the use of green manure crops and barnyard manure are necessary for sustained crop yields. If properly managed, this soil is well suited to all crops commonly grown in the county. Capability unit IIe–6; woodland suitability subclass 2c.

KhC2—Kewaunee silt loam, 6 to 12 percent slopes, eroded. This sloping soil is on glacial till plains. Most areas are irregular in shape and are 5 to 100 acres in size.

This soil has a profile similar to the one described as representative of the series, but it has a thinner, browner, less friable surface layer and a thinner subsoil. This soil is more susceptible to erosion, and good tilth is more difficult to maintain on this soil. Crop yields generally are lower than on the nearly level and gently sloping Kewaunee silt loams.

Included with this soil in mapping are small areas of Kolberg soils. Also included are small areas of gently sloping Kewaunee silt loam and small areas of soils that have a loamy substratum or dolomite bedrock at a depth of 40 to 60 inches.

Runoff is medium. The hazard of erosion is moderate, and it is the main limitation of this soil.

Most areas of this soil are used for corn, small grain, legumes, and pasture. Management practices such as erosion control measures and the use of green manure crops and barnyard manure are necessary for sustained crop yields. If properly managed, this soil is moderately well suited to all crops commonly grown in the county. Capability unit IIIe–6; woodland suitability subclass 2c.

KkD3—Kewaunee soils, 12 to 20 percent slopes, severely eroded. These moderately steep soils are on glacial till plains. Most areas are irregular in shape and are 5 to 35 acres in size.

These soils have a profile similar to the one described as representative of the series, but the surface layer is reddish brown silt loam, loam, or clay loam and the

surface layer and subsoil are thinner. These soils are more susceptible to erosion, and good tilth is more difficult to maintain on these soils than on the less steeply sloping Kewaunee soils. They are too steep for the use of most farm implements.

Included with this soil in mapping are small areas of sloping Kewaunee soils. Also included are small areas of soils that have slopes of more than 20 percent.

Runoff is rapid. The hazard of erosion is severe, and it is the main limitation of this soil.

Most areas of this soil are used for permanent hay or unimproved pasture. Management practices that maintain organic-matter content and good tilth, that reduce runoff, and that control erosion are needed. This soil is generally unsuited to row crops commonly grown in the county. Capability unit VIe–6; woodland suitability subclass 2c.

Kiva series

The Kiva series consists of well drained, gently sloping and sloping soils on outwash plains and old beach ridges. The native vegetation is sugar maple, aspen, and some northern white-cedar.

In a representative profile the surface layer is black sandy loam about 3 inches thick. The subsurface layer is brown sandy loam about 2 inches thick. The subsoil is about 13 inches thick; it is dark brown, very friable sandy loam in the upper part and reddish brown, very friable sandy loam in the lower part. The substratum is brown, stratified, loose sand and gravel to a depth of about 60 inches.

The available water capacity is low. Permeability is moderate in the subsoil and very rapid in the substratum. These soils are seasonally saturated for short periods at a depth of more than 6 feet. The depth of the root zone is limited by the sand and gravel substratum. Natural fertility and the organic-matter content of the surface layer are low.

Most areas of these soils are used for hay, pasture, woodland, or wildlife habitat. They also are an excellent source of sand and gravel.

Representative profile of Kiva sandy loam, 2 to 6 percent slopes, in a wooded area, 300 feet west and 120 feet north of the southeast corner of the SW¼ sec. 14, T. 32 N., R. 28 E.:

O1—1 inch to 0; primarily undecomposed organic material consisting of leaves, grass, and roots.

A1—0 to 3 inches; black (10YR 2/1) sandy loam; moderate medium granular structure; very friable; many roots; neutral; clear wavy boundary.

A2—3 to 5 inches; brown (7.5YR 5/2) sandy loam; weak medium granular structure; very friable; many roots; neutral; abrupt wavy boundary.

B21ir—5 to 13 inches; dark brown (7.5YR 4/4) sandy loam; weak fine subangular blocky structure; very friable; many roots; neutral; clear wavy boundary.

B22ir—13 to 18 inches; reddish brown (5YR 4/4) sandy loam; weak fine subangular blocky structure; very friable; common roots; mildly alkaline; clear wavy boundary.

IIC1—18 to 26 inches; brown (7.5YR 4/4) stratified sand and gravel; single grained; loose; few roots; slightly effervescent; mildly alkaline; clear wavy boundary.

IIC2—26 to 60 inches; brown (7.5YR 5/4) stratified sand and gravel; single grained; loose; slightly effervescent; mildly alkaline.

The solum is 10 to 24 inches thick. It is commonly neutral to mildly alkaline but ranges to slightly acid in some pedons. The A1 horizon is very dark brown, very dark grayish brown, or black sandy loam or gravelly loam. The A2 horizon is brown or pale brown. The B horizon is dark brown or reddish brown sandy loam or loam. The C horizon consists of poorly sorted to well sorted sand and gravel.

Kiva soils are near Alpena, Casco, and Fabius soils. They differ from Alpena soils in that they have a thicker solum. Kiva soils have less clay in the B horizon than Casco and Fabius soils, and they are better drained than Fabius soils.

KmB—Kiva sandy loam, 2 to 6 percent slopes. This gently sloping soil is on outwash plains and low beach ridges. Most areas are elongated or irregular in shape and are 5 to 100 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Alpena soils. Also included are small areas of Kiva sandy loam, 6 to 12 percent slopes, and areas of soils in which dolomite bedrock is at a depth of 40 to 60 inches.

Runoff is slow. The hazard of erosion is moderate. Droughtiness is the main limitation.

Most areas of this soil are used for permanent pasture, native woodland, or wildlife habitat. Management is needed that regularly supplies organic matter and conserves moisture. Because of the low available water capacity, this soil is generally unsuited to crops commonly grown in the county. Gravel pits are common on this soil. Capability unit VIs–5; woodland suitability subclass 2s.

KmC—Kiva sandy loam, 6 to 12 percent slopes. This sloping soil is on old beach ridges. Most areas are elongated in shape and are 5 to 100 acres in size.

This soil has a profile similar to the one described as representative of the series, but it has a thinner surface layer. This soil also is more susceptible to erosion and is more droughty.

Included with this soil in mapping are small areas of Alpena soils. Also included are small areas of Kiva sandy loam, 2 to 6 percent slopes, and areas of soils in which dolomite bedrock is at a depth of 40 to 60 inches.

Runoff is medium. The hazard of erosion is moderate. Droughtiness is the main limitation of this soil.

Most areas of this soil are used for permanent pasture, native woodland, or wildlife habitat. Management is needed that regularly supplies organic matter and conserves moisture. Because of the low available water capacity, this soil is generally unsuited to crops commonly grown in the county. Gravel pits are common on this soil. Capability unit VIs–5; woodland suitability subclass 2s.

Kolberg series

The Kolberg series consists of well drained, nearly level to sloping soils on glacial till plains with underlying dolomite bedrock at a depth of 20 to 40 inches. The native vegetation is mostly red oak and sugar maple.

In a representative profile the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsurface layer, about 2 inches thick, is a mixture of brown silt loam and reddish brown clay loam. The subsoil is about 24 inches thick; the upper part is a mixture of reddish brown, firm clay loam and brown silt loam; the middle part is reddish brown, firm silty clay; and the lower part is reddish brown, firm silty clay loam. The substratum, extending to the underlying dolomite bedrock, is reddish brown, firm heavy loam. Dolomite bedrock is at a depth of about 38 inches.

The available water capacity is moderate. Permeability is moderately slow in the subsoil and moderate in the substratum. Some areas of these soils are seasonally ponded for short periods. Natural fertility is high, and the organic-matter content of the surface layer is moderate.

Most areas of these soils are used for all farm crops commonly grown in the county.

Representative profile of Kolberg silt loam, 2 to 6 percent slopes, in a cultivated field, 200 feet west and 30 feet south of the northeast corner of the SE¼ sec. 35, T. 27 N., R. 23 E.:

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam; moderate medium subangular blocky structure; friable; many roots; neutral; abrupt smooth boundary.

A&B—7 to 9 inches; brown (10YR 5/3) tongues (A2) of silt loam, 15 to 25 millimeters wide, occupy 50 to 70 percent of the horizon; weak medium platy structure; reddish brown (5YR 4/4) clay loam (B2); weak medium subangular blocky structure; friable; neutral; clear wavy boundary.

B&A—9 to 15 inches; reddish brown (5YR 4/4) clay loam (B2); moderate medium subangular blocky structure; firm; brown (7.5YR 4/4) tongues of silt loam (A2), 15 to 25 millimeters wide, penetrate this horizon and occupy 20 to 40 percent of it; weak medium platy structure; neutral; clear wavy boundary.

B21t—15 to 22 inches; reddish brown (5YR 4/4) silty clay; moderate and strong medium subangular blocky structure; firm; continuous clay films on ped faces; neutral; gradual wavy boundary.

B22t—22 to 28 inches; reddish brown (5YR 4/4) silty clay; moderate medium subangular blocky structure; firm; continuous clay films on ped faces; mildly alkaline; clear wavy boundary.

B3—28 to 33 inches; reddish brown (5YR 4/4) silty clay loam; weak medium subangular blocky structure; firm; mildly alkaline; abrupt wavy boundary.

IIC—33 to 38 inches; reddish brown (5YR 5/4) heavy loam; massive, some weak medium subangular blocky structure; firm; slightly effervescent; mildly alkaline; abrupt smooth boundary.

IIR—38 inches; light gray (10YR 7/2) consolidated dolomite bedrock; shattered in the upper few inches and fissured to a depth of 10 feet or more.

Thickness of the solum and depth to underlying dolomite are 20 to 40 inches. The solum is commonly neutral to mildly alkaline. Reaction of the A1 or Ap horizon ranges to medium acid in some pedons. There are tongues of A2 horizon material surrounding columnlike peds of the B horizon or completely surrounding small, isolated remnants of the B horizon. The Bt horizon ranges from dark reddish brown to red. It is dominantly clay or silty clay, but it ranges to silty clay loam or has transitional heavy clay loam horizons in some places. The C horizon is loamy residuum from limestone 2 to 10 inches thick. It is commonly loam or clay loam, but ranges to gravelly loam in some pedons.

Kolberg soils are near Kewaunee, Kolberg Variant, and Longrie soils. Kolberg soils have dolomite bedrock at a depth of 20 to 40 inches, whereas Kewaunee soils have dolomite bedrock at a depth of more than 40 inches and Kolberg Variant soils have it at a depth of less than 20 inches. Kolberg soils formed in heavier textured glacial till than Longrie soils.

KoA—Kolberg silt loam, 0 to 2 percent slopes. This nearly level soil is on glacial till plains that are underlain by dolomite bedrock. Most areas are irregular in shape and are 10 to 100 acres in size.

This soil has a profile similar to the one described as representative of the series, but it has a thicker surface layer. This soil also is less susceptible to erosion.

Included with this soil in mapping are small areas of Kewaunee, Manawa, and Kolberg Variant soils. Also included are small areas of gently sloping Kolberg silt loam and areas of soils in which dolomite bedrock is at a depth of 40 to 60 inches.

Runoff is slow. The hazard of erosion is slight. Brief ponding during wet periods and after rains is the main limitation of this soil. Rainwater does not readily enter the clayey subsoil, and the surface layer becomes saturated. Surface drainage is used to remove water rapidly.

Most areas of this soil are used for corn, small grain, legumes, and pasture. Truck crops are also grown. Management practices such as a good fertilization program and use of green manure crops are necessary for sustained crop yields. If properly managed, this soil is well suited to all crops commonly grown in the county. Capability unit IIs–2; woodland suitability subclass 2c.

KoB—Kolberg silt loam, 2 to 6 percent slopes. This gently sloping soil is on glacial till plains that are underlain by dolomite bedrock. Most areas are irregular in shape and are 5 to 100 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Kewaunee and Kolberg Variant soils. Also included are small areas of nearly level and sloping Kolberg silt

loam and areas of soils in which dolomite bedrock is at a depth of 40 to 60 inches.

Runoff is medium. The hazard of erosion is moderate, and it is the main limitation of this soil.

Most areas of this soil are used for corn, small grain, legumes, and pasture. Truck crops are also grown. Management practices such as erosion control, a good fertilization program, and the use of green manure crops are necessary for sustained crop yields. If properly managed, this soil is well suited to all crops commonly grown in the county. Capability unit IIe–2; woodland suitability subclass 2c.

KoC2—Kolberg silt loam, 6 to 12 percent slopes, eroded. This sloping soil is on glacial plains that are underlain by dolomite bedrock. Most areas are irregular in shape and are 5 to 50 acres in size.

This soil has a profile similar to the one described as representative of the series, but it has a thinner, browner, and less friable surface layer and a thinner subsoil. This soil also is more susceptible to erosion, and good tilth is more difficult to maintain on this soil. Crop yields generally are lower than on the nearly level or gently sloping Kolberg soils.

Included with this soil in mapping are small areas of Kewaunee and Kolberg Variant soils. Also included are small areas of gently sloping Kolberg silt loam, areas of soils in which dolomite bedrock is at a depth of 40 to 60 inches, and a few areas where bedrock is exposed at the surface.

Runoff is medium. The hazard of erosion is moderate, and it is the main limitation of this soil.

Most areas of this soil are used for corn, small grain, legumes, and pasture. Management practices such as erosion control, a good fertilization program, and the use of green manure crops are necessary to sustain crop yields. If properly managed, this soil is moderately well suited to all crops commonly grown in the county. Capability unit IIIe–2; woodland suitability subclass 2c.

Kolberg Variant

The Kolberg Variant consists of well drained, nearly level to sloping soils on glacial till plains where the underlying dolomite bedrock is at a depth of 12 to 24 inches. The native vegetation is mostly red oak and sugar maple.

In a representative profile the surface layer is very dark grayish brown loam about 8 inches thick. The subsoil is about 10 inches thick. It is dark brown, friable loam in the upper part; dark yellowish brown and dark grayish brown, firm clay loam in the middle part; and reddish brown and dark reddish brown, firm clay loam in the lower part. Dolomite bedrock is at a depth of about 18 inches.

The available water capacity is low, and permeability is moderately slow. These soils are seasonally saturated at a depth of 6 feet or more. The depth of the root zone is limited by the dolomite. Natural fertility is medium, and the organic-matter content of the surface layer is moderate.

Most areas of these soils are used for all farm crops commonly grown in the county.

Representative profile of Kolberg Variant loam, 1 to 6 percent slopes, in a cultivated field, 700 feet south and 30 feet east of the northwest corner of sec. 29, T. 26 N., R. 24 E.:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam; weak medium subangular blocky structure; friable; many roots; neutral; abrupt smooth boundary.

Bir—8 to 10 inches; dark brown (10YR 4/3) loam; moderate medium subangular blocky structure; friable; many roots; neutral; abrupt wavy boundary.

B&A—10 to 14 inches; dark yellowish brown (10YR 3/4) and dark grayish brown (10YR 4/2) clay loam; moderate medium subangular blocky structure; firm; albic tongues make up 20 to 40 percent of the horizon; common roots; neutral; clear irregular boundary.

B2t—14 to 16 inches; reddish brown (5YR 4/4) heavy clay loam; weak medium angular blocky structure; firm; common roots; neutral; abrupt wavy boundary.

B3—16 to 18 inches; dark reddish brown (5YR 3/4) clay loam; moderate medium angular blocky structure; firm; common roots; neutral; abrupt wavy boundary.

R—18 inches; light gray (10YR 7/2) consolidated dolomite bedrock.

The solum is neutral to mildly alkaline. The depth to bedrock is 12 to 24 inches. The B2t horizon is dark reddish brown, reddish brown, or red. The Bt horizon is commonly clay loam but ranges to silty clay loam or silty clay.

Kolberg Variant soils are associated with Kolberg and Summerville soils. They have a thinner solum over dolomite bedrock than Kolberg soils and a finer textured subsoil than the typical Summerville soils.

KvB—Kolberg Variant loam, 1 to 6 percent slopes. This nearly level and gently sloping soil is on glacial till plains that are underlain by dolomite bedrock. Most areas are irregular in shape and are 5 to 200 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Kolberg, Namur, and Summerville soils. Also included are small areas of sloping Kolberg Variant loam and areas where dolomite bedrock crops out.

Runoff is medium. The hazard of erosion is slight, and it is the main limitation of this soil.

Most areas of this soil are used for corn, small grain, legumes, and pasture. Management practices such as control of water erosion and the use of green manure crops and barnyard manure are necessary to sustain crop yields. If properly managed, this soil is moderately well suited to all crops commonly grown in the county. Some areas remain in native woodland. Capability unit IIIe–3; woodland suitability subclass 3d.

KvC2—Kolberg Variant loam, 6 to 12 percent slopes, eroded. This sloping soil is on glacial till plains that are underlain by dolomite bedrock. Most areas are irregular in shape and are 5 to 100 acres in size.

This soil has a profile similar to the one described as representative of the variant, but it has a thinner surface layer. This soil has more surface stones and dolomite bedrock exposures. In some places, the upper part

of the subsoil has been incorporated into the plow layer by tillage.

Included with this soil in mapping are small areas of Kolberg, Namur, and Summerville soils. Also included are small areas of gently sloping Kolberg Variant loam.

Runoff is medium. The hazard of erosion is moderate, and it is the main limitation of this soil.

Most areas of this soil are used for corn, small grain, legumes, and pasture. Some areas are in unimproved pasture and native woodland. Management is needed to maintain organic-matter content and good tilth, to reduce runoff, and to control erosion. Even if managed well, this soil is poorly suited to row crops. Capability unit IVe–3; woodland suitability subclass 3d.

Longrie series

The Longrie series consists of well drained, nearly level to sloping soils on glacial till plains where the underlying dolomite bedrock is at a depth of 20 to 40 inches. The native vegetation is red oak, sugar maple, and white birch.

In a representative profile the surface layer is black loam 3 inches thick. The subsurface layer is dark grayish brown sandy loam about 2 inches thick. The subsoil is about 18 inches thick. It is dark brown, friable sandy loam in the upper part; reddish brown, friable sandy loam in the middle part; and brown, friable loam in the lower part. The substratum is brown, very friable fine sandy loam about 7 inches thick. Dolomite bedrock is at a depth of about 30 inches.

The available water capacity is low, and permeability is moderate. These soils are seasonally saturated at a depth of 6 feet or more. The depth of the root zone is limited by the bedrock. Natural fertility is medium, and the organic-matter content of the surface layer is moderate.

Most areas of these soils are used for all farm crops commonly grown in the county.

Representative profile of Longrie loam, 2 to 6 percent slopes, in a wooded area, 260 feet west and 40 feet south of the center of sec. 29, T. 29 N., R. 26 E.:

A1—0 to 3 inches; black (10YR 2/1) loam; moderate medium granular structure; friable; many roots; neutral; abrupt wavy boundary.

A2—3 to 5 inches; dark grayish brown (10YR 4/2) sandy loam; weak medium granular structure; friable; many roots; slightly acid; abrupt smooth boundary.

B21ir—5 to 8 inches; dark brown (7.5YR 4/4) sandy loam; weak medium subangular blocky and weak medium granular structure; friable; many roots; medium acid; abrupt wavy boundary.

B22ir—8 to 14 inches; reddish brown (5YR 4/4) sandy loam; moderate medium subangular blocky structure; friable; common roots; thin patchy clay film in pores; neutral; clear wavy boundary.

B3—14 to 23 inches; brown (7.5YR 4/4) light loam; moderate medium subangular blocky structure; friable; common roots; neutral; clear wavy boundary.

C—23 to 30 inches; brown (10YR 5/3) fine sandy loam; weak medium granular structure; very friable; slightly effervescent; mildly alkaline.

R—30 inches; light gray (10YR 7/2) consolidated bedrock.

The solum is medium acid to neutral. Depth to dolomite bedrock is 20 to 40 inches. In some areas, the solum contains as much as 12 percent coarse fragments of gravelly, cobbly, flaggy, and stony sizes throughout. The A1 horizon is black, very dark brown, or very dark gray. In cultivated areas, the Ap horizon is very dark gray, dark brown, or very dark brown. The A2 horizon is sandy loam or loam. The Bir horizon is brown or dark brown and is sandy loam or loam. The B3 horizon is predominantly reddish brown, brown, or dark brown. It is commonly loam but ranges to sandy loam or fine sandy loam. The C horizon is brown, light yellowish brown, or light brown sandy loam, loam, or fine sandy loam. It is dominantly mildly alkaline but ranges to moderately alkaline in places.

Longrie soils are near Bonduel, Duel, Emmet, Kolberg, and Summerville soils. They are better drained than Bonduel soils and have less sand than Duel soils. Longrie soils are underlain by dolomite bedrock at a depth of 20 to 40 inches, whereas Summerville soils have bedrock at a depth of 10 to 20 inches, and Emmet soils generally have dolomite bedrock at a depth of more than 5 feet. Longrie soils have more sand throughout the profile than Kolberg soils.

LoA—Longrie loam, 0 to 2 percent slopes. This nearly level soil is on glacial till plains that are underlain by dolomite bedrock. Most areas are irregular in shape and are 5 to 200 acres in size.

This soil has a profile similar to the one described as representative of the series, but it has a thicker surface layer. This soil also is less susceptible to erosion.

Included with this soil in mapping are small areas of Kolberg Variant and Summerville soils. Also included are small areas of gently sloping Longrie loam and areas of soils in which dolomite bedrock is at a depth of 40 to 60 inches. Bedrock is exposed at the surface in some areas of this soil.

Runoff is slow. The hazard of erosion is slight. Droughtiness is the main limitation of this soil.

Most areas of this soil are used for corn, small grain, legumes, and pasture. Some areas remain in native woodland. Management practices such as the use of green manure crops and barnyard manure are necessary to sustain crop yields. If properly managed, this soil is well suited to most crops commonly grown in the county. Capability unit IIs–1; woodland suitability subclass 2o.

LoB—Longrie loam, 2 to 6 percent slopes. This gently sloping soil is on glacial till plains that are underlain by dolomite bedrock. Most areas are irregular in shape and are 5 to 400 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Kolberg Variant and Summerville soils. Also included are small areas of nearly level and sloping Longrie loams. In a few areas, dolomite bedrock is at a depth of 40 to 60 inches or is exposed at the surface.

Runoff is medium. The hazard of erosion is moderate, and it is the main limitation of this soil.

Most areas of this soil are used for corn, small grain, legumes, and pasture. Some areas remain in native woodland. Management practices such as erosion control and use of green manure crops and barnyard manure are necessary to sustain crop yields. If properly managed, this soil is well suited to most crops commonly grown in the county. Capability unit IIe–2; woodland suitability subclass 2o.

LoC—Longrie loam, 6 to 12 percent slopes. This sloping soil is on glacial till plains that are underlain by dolomite bedrock. Most areas are irregular in shape and are 5 to 400 acres in size.

This soil has a profile similar to the one described as representative of the series, but it has a thinner surface layer. This soil is more susceptible to erosion, is somewhat droughty, and generally produces lower yields than the representative soil.

Included with this soil in mapping are small areas of Emmet and Summerville soils. Also included are small areas of gently sloping Longrie soils. Dolomite bedrock is exposed at the surface in a few areas of this soil.

Runoff is rapid. The hazard of erosion is moderate, and it is the main limitation of this soil.

Most areas of this soil are used for corn, small grain, legumes, and pasture. Some areas remain in native woodland. Management practices such as erosion control and use of green manure crops and barnyard manure are necessary to sustain crop yields. If properly managed, this soil is moderately well suited to most crops commonly grown in the county. Capability unit IIIe–2; woodland suitability subclass 2o.

Manawa series

The Manawa series consists of somewhat poorly drained, nearly level and gently sloping soils in waterways and shallow depressions on glacial till plains. The native vegetation is American elm, white ash, and willow.

In a representative profile the surface layer is very dark brown silt loam about 8 inches thick. The subsurface layer is mottled, brown silty clay loam about 4 inches thick. The subsoil is mottled, reddish brown, very firm silty clay 16 inches thick. The substratum is reddish brown, firm silty clay to a depth of about 60 inches.

The available water capacity is moderate and permeability is slow. In undrained areas these soils have a seasonal high water table at a depth of 1 to 3 feet. In undrained areas, the depth of the root zone is limited by the water table. Natural fertility is high, and the organic-matter content of the surface layer is moderate.

If drained, most areas of these soils are used for pasture or for general farm crops commonly grown in the county. Undrained areas provide good wetland wildlife habitat. Some areas are used for unimproved pasture.

Representative profile of Manawa silt loam, 0 to 3 percent slopes, in an uncultivated area, 1,310 feet south and 800 feet west of the northeast corner of sec. 10, T. 26 N., R. 23 E.:

A1—0 to 8 inches; very dark brown (10YR 2/2) silt loam; weak medium subangular blocky structure; friable; many roots; neutral; clear wavy boundary.

A2—8 to 12 inches; brown (10YR 5/3) silty clay loam; many coarse faint brown (7.5YR 4/4) mottles; moderate medium subangular blocky structure; firm; many roots; few small weathered yellowish brown (10YR 5/6) dolomite fragments; mildly alkaline; abrupt wavy boundary.

IIB21t—12 to 16 inches; reddish brown (5YR 4/4) silty clay; common fine prominent yellowish red (5YR 5/8) and common fine distinct pinkish gray (7.5YR 6/2) mottles; strong medium subangular blocky structure; very firm; thin patchy clay films on ped faces; many roots; mildly alkaline; clear smooth boundary.

IIB22t—16 to 21 inches; reddish brown (5YR 4/4) silty clay; common medium distinct yellowish red (5YR 5/6) and few fine distinct pinkish gray (7.5YR 6/2) mottles; moderate medium subangular blocky structure; very firm; thick patchy clay films on ped faces; mildly alkaline; clear wavy boundary.

IIB23t—21 to 28 inches; reddish brown (5YR 4/4) silty clay; common medium prominent yellowish red (5YR 5/8) and common medium faint brown (7.5YR 5/4) mottles; moderate medium subangular blocky structure; very firm; mildly alkaline; clear wavy boundary.

IIC—28 to 60 inches; reddish brown (5YR 4/4) silty clay; weak medium subangular blocky structure; firm; strongly effervescent; moderately alkaline.

The solum is 20 to 36 inches thick. It is generally neutral or mildly alkaline but ranges to slightly acid or moderately alkaline in some pedons. The Bt horizon is generally silty clay or clay but in some places it ranges to silty clay loam. It is typically reddish brown. The C horizon is typically silty clay, but ranges to silty clay loam or clay. Content of coarse fragments ranges from 0 to 10 percent, by volume.

In Door County, the annual temperature of these soils is a few degrees cooler than the defined range for the series, but this difference does not alter their usefulness or behavior.

Manawa soils are near Kewaunee and Poygan soils. They are wetter than Kewaunee soils and not so wet as Poygan soils.

McA—Manawa silt loam, 0 to 3 percent slopes. This nearly level and gently sloping soil is in waterways and shallow depressions on glacial till plains. Most areas are elongated or irregular in shape and are 3 to 50 acres in size.

Included with this soil in mapping are small areas of Kewaunee and Poygan soils. Also included are very small areas of soils that have a sandy loam surface layer.

Runoff is slow. The hazard of erosion is slight. Wetness is the main limitation of this soil. This soil receives runoff from adjoining areas and is likely to be ponded for brief periods during wet seasons and after heavy rains. Surface drainage removes excess water rapidly. Deep ditches and field tiles provide internal drainage.

If drained, this soil is suited to corn, small grain,

legumes such as red clover, and pasture. Some truck crops are also grown. Undrained areas are used for unimproved pasture, but are better suited to wetland wildlife habitat than to most other uses. Capability unit IIw–2; woodland suitability subclass 2o.

Manistee series

The Manistee series consists of well drained and moderately well drained, gently sloping soils on sandy outwash plains and ridges. The native vegetation is mainly sugar maple and red oak.

In a representative profile the surface layer is very dark grayish brown loamy sand about 8 inches thick. The subsurface layer is grayish brown sand about 2 inches thick. The subsoil is about 28 inches thick; it is reddish brown and dark brown, loose sand in the upper part and reddish brown, very firm silty clay in the lower part. The substratum is reddish brown, very firm silty clay to a depth of about 60 inches.

The available water capacity is low. Permeability is rapid in the upper part of the subsoil and slow in the lower part of the subsoil and in the substratum. These soils are seasonally saturated at a depth of 2.5 to 6 feet or more. The depth of the root zone is generally more than 6 feet. Natural fertility and the organic-matter content of the surface layer are low.

Most areas of these soils are used for all farm crops commonly grown in the county.

Representative profile of Manistee loamy sand, 2 to 6 percent slopes, in a cultivated field, 2,060 feet west and 600 feet south of the northeast corner of the NW¼ sec. 33, T. 26 N., R. 23 E.:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loamy sand; weak medium granular structure; very friable; many roots; slightly acid; abrupt smooth boundary.

A2—8 to 10 inches; grayish brown (10YR 5/2) sand; single grained; loose; many roots; roots; neutral; clear wavy boundary.

B21ir—10 to 15 inches; reddish brown (5YR 4/4) sand; single grained; loose; common roots; neutral; abrupt wavy boundary.

B22ir—15 to 32 inches; dark brown (7.5YR 4/4) sand; single grained; loose; common roots; neutral; clear wavy boundary.

B23ir—32 to 34 inches; reddish brown (5YR 4/4) sand; single grained; loose; clay bridging between some sand grains; common roots; neutral; clear wavy boundary.

IIB2t—34 to 38 inches; reddish brown (5YR 4/4) silty clay; strong medium angular blocky structure; very firm; thin patchy clay films on ped faces; neutral; clear wavy boundary.

IIC—38 to 60 inches; reddish brown (5YR 5/4) silty clay; moderate medium angular blocky structure; very firm; strongly effervescent; mildly alkaline.

The solum is commonly slightly acid to neutral but ranges to strongly acid in some pedons. The C horizon is dominantly mildly alkaline but ranges from medium acid to moderately alkaline in places. The Bir horizon is dark brown, brown, or reddish brown sand or loamy sand. Depth to the clayey horizons ranges from 20 to 40 inches. The clayey horizons are reddish brown silty clay or clay. Contents of coarse fragments in the IIC horizon ranges from 0 to 10 percent, by volume.

In Door County, these soils lack an eluvial horizon between the spodic and argillic horizons and the argillic horizon is thinner than the defined range for the series. These differences do not alter usefulness and behavior.

Manistee soils are near Allendale, Kewaunee, and Rousseau soils. They lack the mottles that are characteristic of Allendale soils, and they have more sand in the A horizon and upper part of the B horizon than Kewaunee soils. Manistee soils are clayey in the lower part of the B horizon and in the C horizon, whereas Rousseau soils are not.

MeB—Manistee loamy sand, 2 to 6 percent slopes. This gently sloping soil is on sandy outwash plains. Most areas are elongated in shape and are 5 to 50 acres in size.

Included with this soil in mapping are small areas of Allendale and Rousseau soils. Also included are small areas of sloping Manistee loamy sand and some small areas of soils that have a sandy loam surface layer.

Runoff is slow. The hazard of erosion is moderate, and it is the main limitation of this soil.

Most areas of this soil are used for growing corn, small grain, legumes, and pasture. Many areas remain in native woodland. Management practices such as protection from soil blowing and water erosion and the use of green manure crops and barnyard manure are needed to sustain crop yields. If properly managed, this soil is moderately well suited to all crops commonly grown in the county. Capability unit IIIs–3; woodland suitability subclass 3o.

Markey series

The Markey series consists of very poorly drained, nearly level, organic soils in glacial lake basins and in depressions in stream valleys. These soils are underlain by outwash sand. The native vegetation is white-cedar, white ash, alder, and redosier dogwood.

In a representative profile the upper 28 inches is black and very dark brown muck that contains about 10 percent recognizable plant fibers if undisturbed. The substratum is grayish brown loose sand in the upper 8 inches and gray loose sand to a depth of 60 inches.

The available water capacity is high. Permeability is moderately rapid in the organic material and rapid in the substratum. These soils are saturated at a depth of less than 1 foot, unless they are drained. If the soils are not drained, the depth of the root zone is limited by the water table. Natural fertility is low, and the organic-matter content of the surface layer is very high.

If drained, areas of these soils are used for most general farm crops commonly grown in the county. Undrained areas of these soils provide good wetland wildlife habitat. A few areas are used for unimproved pasture.

Representative profile of Markey muck in a wooded area, 1,280 feet east and 1,100 feet north of the southwest corner of the SE¼ sec. 31, T. 28 N., R. 25 E.:

Oa1—0 to 14 inches; black (N 2/0) broken face

and rubbed sapric material; about 10 percent fibers, less than 5 percent rubbed; weak medium granular structure; nonsticky; primarily herbaceous fibers; neutral; clear smooth boundary.

Oa2—14 to 28 inches; very dark brown (10YR 2/2) broken face and rubbed sapric material; about 25 percent fibers, less than 10 percent rubbed; weak medium subangular blocky structure; nonsticky; primarily herbaceous fibers; neutral; clear smooth boundary.

IIC1—28 to 36 inches; grayish brown (10YR 5/2) sand; single grained; loose; mildly alkaline; gradual wavy boundary.

IIC2g—36 to 60 inches; gray (10YR 6/1) sand; single grained; loose; mildly alkaline.

The organic horizons are commonly neutral and are 16 to 50 inches thick. They are primarily sapric material from herbaceous plants but include some woody fragments in places. In some pedons the reaction ranges from medium acid to mildly alkaline. The organic horizons are black, very dark gray, or very dark brown. The IIC horizon is sand or loamy sand. Reaction is commonly mildly alkaline but ranges from slightly acid to moderately alkaline.

Markey soils are near Carbondale and Deford soils. They are underlain by sand at a depth of 16 to 50 inches, whereas Carbondale soils are underlain by mineral material at a depth of more than 51 inches. Markey soils do not have the sandy upper part of the profile that is characteristic of the poorly drained Deford soils.

Mk—Markey muck. This nearly level soil is in old glacial lake basins and in depressions on flood plains. Slopes are 0 to 2 percent. Most areas are irregular in shape and are 5 to 100 acres in size.

Included with this soil in mapping are small areas of Carbondale, Cathro, and Deford soils. Also included are small areas of Markey soils that have 2 to 6 percent slopes.

Runoff is very slow. The hazard of erosion is slight. Wetness is the main limitation of this soil. This soil is likely to be ponded during wet seasons and after heavy rains. Surface drainage removes excess water rapidly. Deep ditches and subsurface drainage can be used to remove internal water where outlets are available. Where tile drainage is used, loose sand enters the tile lines unless precautions are taken to prevent its entry. Subsidence is a management concern if the water table is lowered too far.

Even if drained, this soil is poorly suited to most crops commonly grown in the county because of the frost hazard. Undrained areas are used for unimproved pasture, but are better suited to wetland wildlife habitat than to other uses. Capability unit VIw–7; woodland suitability subclass 3w.

Namur series

The Namur series consists of well drained, nearly level to sloping soils on glacial till plains where the underlying dolomite bedrock is at a depth of 5 to 12 inches. The native vegetation is red oak, sugar maple, thornapple, and eastern redcedar.

In a representative profile the surface layer is very dark grayish brown loam about 5 inches thick. The subsoil is brown, firm heavy loam about 3 inches thick. Dolomite bedrock is at a depth of about 8 inches.

The available water capacity is very low, and permeability is moderate. These soils are seasonally saturated at a depth of 6 feet or more. The depth of the root zone is limited by the dolomite bedrock. Natural fertility is low, and the organic-matter content of the surface layer is moderate.

Most areas of these soils are used for permanent pasture, native woodland, or wildlife habitat.

Representative profile of Namur loam, 0 to 6 percent slopes, in a cultivated field, 440 feet east and 330 feet north of the southwest corner of the SE¼ sec. 29, T. 29 N., R. 26 E.:

Ap—0 to 5 inches; very dark grayish brown (10YR 3/2) loam; weak medium and fine subangular blocky structure; very friable; neutral; abrupt smooth boundary.

B2—5 to 8 inches; brown (7.5YR 4/4) heavy loam; weak fine and coarse subangular blocky structure; firm; mildly alkaline; abrupt wavy boundary.

R—8 inches; dolomite bedrock.

The solum is neutral to mildly alkaline. The depth to dolomite bedrock ranges from 5 to 12 inches. The A horizon is very dark brown, very dark grayish brown, or dark brown. The B horizon is absent in most areas where bedrock is at a depth of less than 7 inches. The underlying bedrock is creviced in many places.

Namur soils are near Bonduel Shallow Variant, Namur Variant, and Summerville soils. They are not so wet as Bonduel Variant and Namur Variant soils, and are not so deep to dolomite as Summerville soils.

NaB—Namur loam, 0 to 6 percent slopes. This nearly level and gently sloping soil is on glacial till plains that are underlain by dolomite bedrock. Most areas are irregular in shape and are 5 to 150 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Bonduel Shallow Variant, Namur Variant, and Summerville soils. Also included are small areas of sloping Namur loam. Dolomite or shale bedrock outcrops are in some areas of this soil.

Runoff is medium. The hazard of erosion is moderate. Droughtiness is the main limitation of this soil.

Although a few areas are cropped, most areas of this soil are used for unimproved pasture or remain in native woodland. Management is needed to supply regular additions of organic matter and to conserve moisture. This soil is generally unsuited to crops commonly grown in the county. It is better suited to woodland or wildlife habitat than to most other uses. Capability unit VIs–5; woodland suitability subclass 4d.

NaC—Namur loam, 6 to 12 percent slopes. This sloping soil is on glacial till plains that are underlain by dolomite bedrock. Most areas are irregular in shape and are 5 to 100 acres in size.

This soil has a profile similar to the one described as representative of the series, but it is more susceptible to erosion. Surface stones and exposures of dolomite bedrock also are more extensive.

Included with this soil in mapping are small areas of Summerville soils. Also included are small areas of moderately steep Namur soils.

Runoff is medium. The hazard of erosion is moderate. Droughtiness is the main limitation of this soil.

Most areas of this soil are used for unimproved pasture or remain in native woodland. Management is needed to supply regular additions of organic matter and to conserve moisture. This soil is generally unsuited to crops commonly grown in the county. It is better suited to woodland or wildlife habitat than to most other uses. Capability unit VIs–5; woodland suitability subclass 4d.

Namur Variant

The Namur Variant consists of somewhat poorly drained, nearly level soils in depressions of glacial till plains where the underlying dolomite bedrock is at a depth of 5 to 10 inches. The native vegetation is white ash, American elm, sugar maple, and northern white-cedar.

In a representative profile about an inch of partially decomposed leaves and roots overlies a mineral surface layer of black loam about 5 inches thick. The subsoil is mottled, reddish gray, friable very fine sandy loam about 4 inches thick. Dolomite bedrock is at a depth of about 9 inches.

The available water capacity is very low, and permeability is moderate. These soils are seasonally saturated at a depth of 1 to 3 feet. The depth of the root zone is limited by the bedrock. Natural fertility is low, and the organic-matter content of the surface layer is moderate.

Most areas of these soils remain in unimproved pasture or woodland.

Representative profile of Namur Variant loam in a wooded area, 1,600 feet west and 860 feet north of the southeast corner of the NE¼ sec. 24, T. 30 N., R. 26 E.:

Oa1—1 inch to 0; black (5YR 2/1) partly decomposed leaves and roots.

A1—0 to 5 inches; black (10YR 2/1) loam; weak medium subangular blocky structure; very friable; mildly alkaline; abrupt smooth boundary.

B2g—5 to 9 inches; reddish gray (5YR 5/2) very fine sandy loam; common fine prominent dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; friable; few black (10YR 2/1) worm casts; many flaggy light brown (7.5YR 6/4) pieces of dolomite in lower 2 inches; mildly alkaline; abrupt wavy boundary.

R—9 inches; light gray (10YR 7/2) consolidated dolomite bedrock.

The solum is mildly alkaline and is underlain by dolomite bedrock at a depth of 5 to 10 inches. The B horizon is absent in most areas where bedrock is at a depth of less than 8 inches.

Namur Variant soils are near Namur and Summerville soils, and they are wetter than these well drained soils.

Nv—Namur Variant loam. This nearly level soil is in depressions on glacial till plains that are underlain by dolomite bedrock. Slopes are 0 to 2 percent. Most areas are irregular in shape and are 5 to 40 acres in size. Dolomite flagstones are common in this soil.

Included with this soil in mapping are small areas of Namur soils. Also included are areas of soils in which dolomite bedrock is at a depth of 12 to 20 inches.

Runoff is slow. The hazard of erosion is slight. Depth to bedrock is the main limitation of this soil. This soil receives runoff from adjoining areas and is likely to be ponded for brief periods during wet seasons and after heavy rains. Surface drainage removes excess water rapidly. The underlying dolomite bedrock prevents the use of deep ditches and tile drains.

This soil is used mainly for unimproved pasture or native woodland. It is generally unsuited to crops commonly grown in the county. It is better suited to woodland or wetland wildlife habitat than to most other uses. Capability unit VIs–5; woodland suitability subclass 5w.

Omena series

The Omena series consists of well drained, gently sloping to moderately steep soils on glacial till plains and morainic ridges (fig. 4). The native vegetation is sugar maple, red oak, and American beech.

In a representative profile the surface layer is very dark gray sandy loam about 3 inches thick. The subsurface layer is grayish brown sandy loam about 2 inches thick. The subsoil is about 12 inches thick. The upper part of the subsoil is dark brown, friable sandy loam in the upper part; the next part is brown, friable sandy loam that is slightly hard when dry; the next part is dark reddish brown, friable heavy loam; and the lower part is dark brown, friable loam. The substratum is light brown, friable sandy loam to a depth of about 60 inches.

The available water capacity and permeability are moderate. These soils are seasonally saturated at a depth of more than 6 feet. The depth of the root zone is more than 6 feet. Natural fertility and the organic-matter content of the surface layer are low.

Most gently sloping and sloping areas of these soils are used for all farm crops commonly grown in the county. Most moderately steep areas are used for hay, pasture, woodland, or wildlife habitat.

Representative profile of Omena sandy loam, 6 to 12 percent slopes, in a wooded area, 600 feet south and 30 feet east of the center of sec. 35, T. 32 N., R. 28 E.:

A1—0 to 3 inches; very dark gray (10YR 3/1) sandy loam; weak medium granular structure; very friable; many roots; neutral; abrupt smooth boundary.

A2—3 to 5 inches; grayish brown (10YR 5/2) sandy loam; weak medium granular structure; very friable; many roots; neutral; abrupt wavy boundary.

B2hir—5 to 9 inches; dark brown (7.5YR 4/4) sandy loam; weak medium subangular blocky structure; friable; many roots; neutral; clear wavy boundary.

A'2—9 to 10 inches; brown (10YR 5/3) sandy loam; moderate medium subangular blocky structure; friable; common roots;

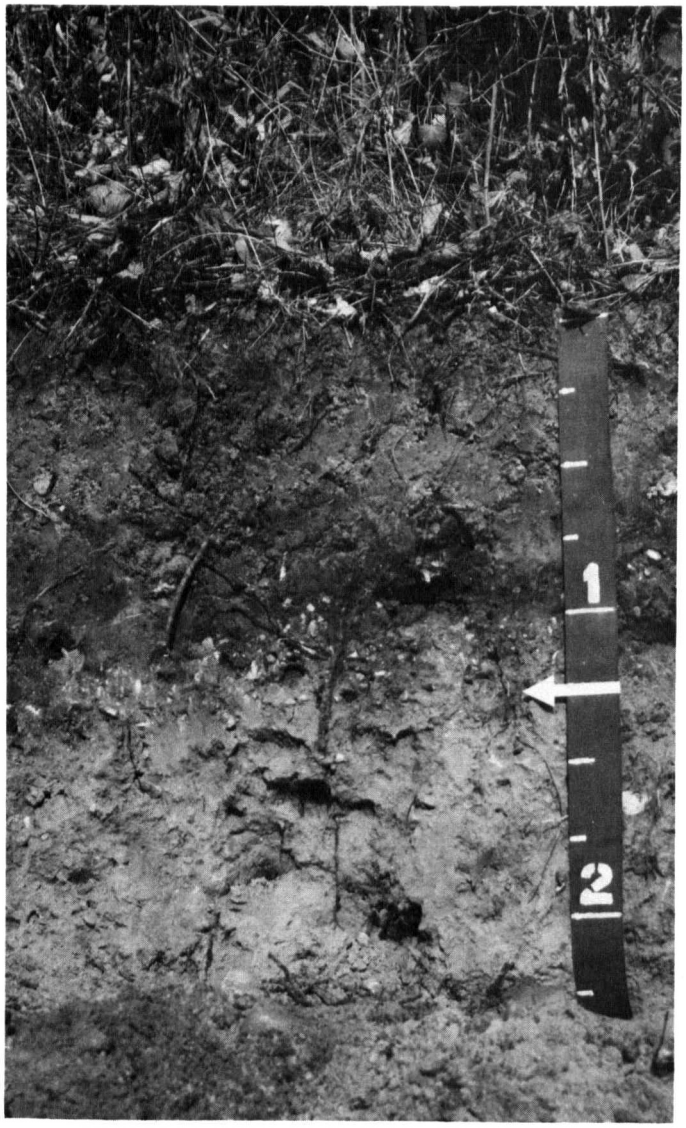

Figure 4.—**Profile of Omena sandy loam.**

discontinuous horizon; neutral; abrupt irregular boundary.

B'2t—10 to 12 inches; dark reddish brown (5YR 3/4) heavy loam; weak medium subangular blocky structure; friable; clay bridging of sand grains, thickness ranges from 1 to 3 inches; neutral; clear wavy boundary.

B'3t—12 to 17 inches; dark brown (7.5YR 4/4) loam; weak and moderate medium subangular blocky structure; friable; few thin clay films in pores; neutral; abrupt wavy boundary.

C—17 to 60 inches; light brown (7.5YR 6/4) sandy loam; weak medium subangular blocky structure; friable; about 12 percent, by volume, coarse fragments; strongly effervescent; mildly alkaline.

The solum is 14 to 20 inches thick in undisturbed sites, and 12 to 18 inches thick in cultivated areas. The solum is commonly neutral to mildly alkaline but ranges to slightly acid in some pedons. The C horizon is dominantly mildly alkaline but ranges to moderately alkaline. The A1 or Ap horizon is very dark brown, very dark gray, very dark grayish brown, and dark brown. In cultivated areas, the A2 horizon, and most or all of the Bir horizon, is incorporated into the plowed layer. The A'2 horizon is not in some pedons, especially where the solum is less than 16 inches thick. The Bt horizon is reddish brown, dark reddish brown, or dark brown. It is sandy loam or loam and has a weighted clay content estimated at 10 to 18 percent. In some pedons the texture ranges to sandy clay loam or clay loam. Coarse fragments make up 5 to 20 percent, by volume, of the C horizon.

Omena soils are near Angelica and Emmet soils. They have a thinner solum than Emmet soils and are better drained than Angelica soils.

OmB—Omena sandy loam, 2 to 6 percent slopes. This gently sloping soil is on glacial till plains. Most areas are irregular in shape and are 5 to 200 acres in size.

This soil has a profile similar to the one described as representative of the series, but it has a thicker surface layer. This soil also is less susceptible to erosion and generally produces higher crop yields.

Included with this soil in mapping are small areas of Omena Variant and Emmet soils. Also included are small areas of nearly level and sloping Omena sandy loams, and some small areas of soils that are underlain by dolomite bedrock at a depth of 40 to 60 inches.

Runoff is slow. The hazard of erosion is moderate, and it is the main limitation of this soil.

Most areas of this soil are used for corn, small grain, legumes, and pasture. Truck crops and fruit trees are also grown. Management practices such as protection from water erosion and maintenance of organic matter are necessary for sustained crop production. If properly managed, this soil is well suited to all crops, including orchard crops, commonly grown in the county. Capability unit IIe–2; woodland suitability subclass 3o.

OmC—Omena sandy loam, 6 to 12 percent slopes. This sloping soil is on low ridges on glacial till plains. Most areas are irregular in shape and are 5 to 200 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Emmet soils. Also included are small areas of gently sloping and moderately steep Omena sandy loams, and small areas of soils in which dolomite bedrock is at a depth of 40 to 60 inches.

Runoff is medium. The hazard of erosion is moderate, and it is the main limitation of this soil.

Most areas of this soil are used for corn, small grain, legumes, and pasture. Truck crops and fruit trees are also grown. Management practices such as protection from water erosion and maintenance of organic matter are necessary for sustained crop production. If properly managed, this soil is moderately well suited to row crops commonly grown in the county and to orchard crops. Capability unit IIIe–2; woodland suitability subclass 3o.

OmD—Omena sandy loam, 12 to 20 percent slopes. This moderately steep soil is on morainic ridges of

glacial till plains. Most areas are irregular in shape and are 5 to 100 acres in size.

This soil has a profile similar to the one described as representative of the series, but it has a thinner surface layer and subsoil. This soil is also more susceptible to erosion and generally produces lower yields. This soil is too steep for the use of most farm implements.

Included with this soil in mapping are small areas of sloping Omena sandy loam.

Runoff is medium. The hazard of erosion is severe, and it is the main limitation of this soil.

Most areas of this soil are used for permanent hay, unimproved pasture, native woodland, or wildlife habitat. Management is needed to maintain organic matter content and good tilth, to reduce runoff, and to control erosion. This soil is poorly suited to row crops commonly grown in the county. Capability unit IVe–2; woodland suitability subclass 3r.

Omena Variant

The Omena Variant consists of somewhat poorly drained, gently sloping soils in seepage areas on glacial till plains. The native vegetation is American elm, white ash, sugar maple, and some white-cedar.

In a representative profile the surface layer is very dark grayish brown sandy loam about 7 inches thick. The subsoil is about 8 inches thick and is mottled; it is dark yellowish brown, friable light loam in the upper part and yellowish brown, friable fine sandy loam in the lower part. The substratum is mottled, pale brown, friable fine sandy loam to a depth of about 60 inches.

The available water capacity is high, and permeability is moderate. These soils are seasonally saturated at a depth of 1 to 3 feet, unless they are drained. If the soils are not drained, the depth to the root zone is limited by the water table. Natural fertility and the organic-matter content of the surface layer are low.

Most areas of these soils are used for pasture or for general farm crops commonly grown in the county. Spring tillage is delayed where these soils are not drained. Some undrained areas are used for unimproved pasture or woodland.

Representative profile of Omena Variant sandy loam, 2 to 6 percent slopes, in a cultivated field, 1,140 feet west and 30 feet south of the northeast corner of the SE¼ sec. 11, T. 26 N., R. 24 E.:

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) sandy loam; weak medium subangular blocky structure; friable; many roots; neutral; abrupt smooth boundary.

B2—7 to 9 inches; dark yellowish brown (10YR 4/4) light loam; few fine distinct yellowish brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; friable; mildly alkaline; clear wavy boundary.

B3—9 to 15 inches; yellowish brown (10YR 5/4) fine sandy loam; common fine distinct strong brown (7.5YR 5/6) and light gray (10YR 7/2) mottles; moderate medium subangular blocky structure; friable; mildly alkaline; clear wavy boundary.

C—15 to 60 inches; pale brown (10YR 6/3) fine sandy loam; many medium prominent strong brown (7.5YR 5/6) and many medium faint light gray (10YR 7/2) mottles; weak thick platy structure parting to weak coarse subangular blocky; friable; strongly effervescent; mildly alkaline.

The solum is 12 to 20 inches thick and is commonly neutral to mildly alkaline. In some pedons, reaction of the solum and C horizon ranges to moderately alkaline. The Ap or A1 horizon is very dark brown, very dark gray, or very dark grayish brown and is generally sandy loam. In cultivated areas, the A2 horizon is incorporated into the plow layer. The B horizon is brown, dark yellowish brown, or yellowish brown. It is light loam, fine sandy loam, or sandy loam and has a weighted clay content estimated at less than 18 percent. Mottles are generally common throughout the B horizon and range from few to many. The C horizon is pale brown or light yellowish brown and has common or many mottles. Pockets of stratified silt and very fine sand are common. Content of coarse fragments ranges from 5 to 15 percent, by volume.

Omena Variant soils are near Emmet and Omena soils. They have mottles in the B and C horizons, which Emmet and Omena soils do not have. Omena Variant soils have a thinner solum than Emmet soils.

OvB—Omena Variant sandy loam, 2 to 6 percent slopes. This gently sloping soil is on glacial till plains. Most areas are elongated in shape and are 5 to 100 acres in size.

Included with this soil in mapping are small areas of Emmet and Omena soils. Also included are small areas of soils that have slopes as much as 8 percent, and areas of poorly drained soils.

Runoff is medium. The hazard of erosion is moderate. Wetness is the main limitation of this soil. This soil receives runoff from adjoining areas and is likely to be ponded for brief periods during wet seasons and after heavy rains. Surface drainage removes excess water rapidly. Deep ditches and field tile provide internal drainage.

If drained, this soil is suited to corn, small grain, legumes such as red clover, and pasture. Tillage is delayed in spring if this soil is not drained. Undrained areas are also used for unimproved pasture but are better suited to woodland or to wetland wildlife habitat. Capability unit IIw–2; woodland suitability subclass 2o.

Omro series

The Omro series consists of well drained, gently sloping soils on glacial till plains. The native vegetation is red oak and sugar maple.

In a representative profile the surface layer is very dark grayish brown silt loam about 6 inches thick. The subsoil is about 24 inches thick. It is reddish brown, firm clay loam in the upper part; reddish brown, very firm silty clay in the middle part; and firm, reddish brown heavy clay loam in the lower part. The substratum is light yellowish brown, friable fine sandy loam to a depth of about 60 inches.

The available water capacity is high. Permeability is moderately slow in the subsoil and moderate in the

loamy substratum. Some areas of these soils are seasonally ponded for short periods. Depth of the root zone is more than 6 feet. Natural fertility is high, and the organic-matter content of the surface layer is moderate.

Most areas of these soils are used for all farm crops commonly grown in the county.

Representative profile of Omro silt loam, 2 to 6 percent slopes, in a cultivated field, 330 feet west and 50 feet south of the northeast corner of the NE¼ sec. 17, T. 26 N., R. 24 E.:

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) gritty silt loam, light brownish gray (10YR 6/2) dry; moderate medium and fine subangular blocky structure; friable; few roots; mildly alkaline; abrupt smooth boundary.

B1—6 to 10 inches; reddish brown (5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; few roots; some peds with pinkish gray (7.5YR 7/2), dry, coatings; neutral; clear irregular boundary.

B21t—10 to 18 inches; reddish brown (5YR 4/3) silty clay; moderate fine and medium subangular blocky structure; very firm; few roots; thin patchy clay films on ped faces; neutral; clear wavy boundary.

B22t—18 to 27 inches; reddish brown (5YR 4/3) silty clay; moderate medium and coarse subangular blocky structure; very firm; thin patchy clay films on ped faces; neutral; clear wavy boundary.

B3—27 to 30 inches; reddish brown (5YR 4/4) heavy clay loam; moderate medium subangular blocky structure; firm; slightly effervescent; mildly alkaline; irregular boundary.

IIC—30 to 60 inches; light yellowish brown (10YR 6/4) fine sandy loam; massive parting to weak medium subangular blocky structure; friable; strongly effervescent; moderately alkaline.

The solum is 20 to 32 inches thick and is commonly neutral or mildly alkaline. In some pedons, reaction of the solum ranges to slightly acid. Depth to the loamy IIC horizon is 27 to 40 inches. The Ap horizon is very dark brown, very dark grayish brown, or brown. Where present, the A2 horizon is dark grayish brown or yellowish brown silt loam. The B horizon is dark brown, brown, reddish brown, or yellowish red. It is commonly silty clay or clay, but thin transition clay loam horizons are in some places. Where present, the C1 horizon is heavy silty clay loam or clay loam, and is similar to the B horizon in color. The IIC horizon is brown, very pale brown, or light yellowish brown fine sandy loam and ranges to gravelly sandy loam or loam in some pedons. Content of coarse fragments ranges from 5 to 12 percent, by volume.

In Door County the annual temperature of these soils is a few degrees cooler than the defined range for the series, but this difference does not alter their usefulness and behavior.

Omro soils are near Emmet and Kewaunee soils. They have more clay in the B horizon than Emmet soils, and they do not have the silty clay C horizon of Kewaunee soils.

OzB—Omro silt loam, 2 to 6 percent slopes. This gently sloping soil is on glacial till plains. Most areas are irregular in shape and are 5 to 250 acres in size.

Included with this soil in mapping are small areas of Emmet and Kewaunee soils. Also included are areas of soils that have a loamy substratum or dolomite bedrock at a depth of 40 to 60 inches.

Runoff is medium. The hazard of erosion is moderate, and it is the main limitation of this soil.

Most areas of this soil are used for corn, small grain, legumes, and pasture. Truck crops are also grown. Management practices such as erosion control and use of green manure crops and barnyard manure are necessary for sustained crop yields. If properly managed, this soil is well suited to all crops commonly grown in the county. Capability unit IIe–6; woodland suitability subclass 2c.

Pinconning series

The Pinconning series consists of poorly drained, nearly level soils in depressions of glacial till plains. The native vegetation is white ash, redosier dogwood, and marsh grasses.

In a representative profile the surface layer is black loamy fine sand about 6 inches thick. The substratum is light brownish gray and gray, loose fine sand 21 inches thick in the upper part and reddish brown, very firm silty clay to a depth of about 60 inches. There are thin strata of silt in the lower part of the substratum in some places.

The available water capacity is moderate. Permeability is rapid in the sandy substratum and slow in the lower part of the substratum. These soils are seasonally saturated at a depth of less than 1 foot, unless they are drained. If these soils are not drained, the depth of the root zone is limited by the water table. Natural fertility is low, and the organic-matter content of the surface layer is moderate.

If drained, most areas of these soils are used for pasture or for general farm crops commonly grown in the county. Undrained areas provide good wetland wildlife habitat. Some areas are used for unimproved pasture.

Representative profile of Pinconning loamy fine sand in a wooded area, 440 feet south and 160 feet east of the northwest corner of the SW¼ sec. 26, T. 26 N., R. 23 E.:

A1—0 to 6 inches; black (10YR 2/1) loamy fine sand; moderate fine granular structure; very friable; many roots; slightly acid; abrupt wavy boundary.

C1—6 to 13 inches; light brownish gray (10YR 6/2) fine sand; single grained; loose; neutral; clear wavy boundary.

C2g—13 to 27 inches; gray (10YR 5/1) fine sand; single grained; loose; neutral; abrupt wavy boundary.

IIC3—27 to 30 inches; brown (10YR 5/3) silt; many distinct light reddish brown (5YR 6/4) mottles; massive; friable; strongly effervescent; mildly alkaline; abrupt wavy boundary.

IIC4—30 to 60 inches; reddish brown (5YR 4/3) silty clay; common medium prominent yellowish red (5YR 5/6) mottles; massive; very firm; strongly effervescent; moderately alkaline.

The sandy upper horizons are commonly slightly acid or neutral but range to medium acid in some pedons. The sandy upper sediment is 18 to 36 inches thick. It is sand, loamy sand, or loamy fine sand. In some places there is an organic surface layer as much as 12 inches thick. The IIC horizon is dark reddish brown, dark reddish gray, dark brown, or reddish brown clay or silty clay. Thin layers of silt are in some places. Coarse fragments make up 0 to 10 percent, by volume, of the IIC horizon.

In Door County, the IIC horizon is redder than the defined range for the series, but this difference does not alter the usefulness and behavior of these soils.

Pinconning soils are near Allendale and Poygan soils. They are sandy in the A horizon and upper part of the C horizon, whereas Poygan soils are not. Pinconning soils are wetter than the somewhat poorly drained Allendale soils.

Pn—Pinconning loamy fine sand. This nearly level soil is in depressions on glacial till plains. Slopes are 0 to 2 percent. Most areas are irregular in shape and are 5 to 150 acres in size.

Included with this soil in mapping are small areas of Allendale soils. In some areas, the surface layer is fine sandy loam.

Runoff is slow. The hazard of erosion is slight. Wetness is the main limitation of this soil. This soil receives runoff from adjoining areas and is likely to be ponded during wet seasons and after heavy rains. Surface drainage removes excess surface water rapidly. Deep ditches provide internal drainage.

Some areas of this soil are drained and are used for corn, small grain, or pasture. Even if drained, this soil is poorly suited to crops because of the frost hazard. Some undrained areas are used for unimproved pasture, but are better suited to wetland wildlife habitat than to most other uses. Capability unit IIIw–6; woodland suitability subclass 4w.

Poygan series

The Poygan series consists of poorly drained, nearly level soils in depressions on glacial till plains. The native vegetation is American elm, white ash, and sugar maple.

In a representative profile the surface layer is black silty clay loam about 9 inches thick. The subsoil is about 20 inches thick and is mottled. It is very dark gray, firm silty clay loam in the upper part; gray, firm silty clay in the middle part; and reddish brown, firm silty clay in the lower part. The substratum is mottled reddish brown, very firm silty clay to a depth of about 60 inches.

The available water capacity is moderate, and permeability is slow. These soils are seasonally saturated at a depth of less than 1 foot, unless they are drained. The depth of the root zone is limited by the water table. Natural fertility and the organic-matter content of the surface layer are high.

Representative profile of Poygan silty clay loam in a cultivated field, 150 feet west and 30 feet north of the southeast corner of the SW¼ sec. 18, T. 26 N., R. 24 E.:

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam; moderate medium granular structure; friable; many roots; neutral; abrupt smooth boundary.

B1g—9 to 12 inches; very dark gray (5Y 3/1) silty clay loam; common fine prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; many roots; mildly alkaline; clear irregular boundary.

B2g—12 to 20 inches; gray (10YR 5/1) silty clay; many fine and medium prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; many roots, mildly alkaline; clear irregular boundary.

B3—20 to 29 inches; reddish brown (5YR 4/3) silty clay; common medium prominent strong brown (7.5YR 5/6) and common medium prominent grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; mildly alkaline; gradual irregular boundary.

C—29 to 60 inches; reddish brown (5YR 5/3) silty clay; common medium prominent yellowish red (5YR 4/6) and common fine prominent light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure; very firm; slightly effervescent; mildly alkaline.

The solum is 20 to 30 inches thick and is neutral to mildly alkaline. Uncultivated areas have a thin organic surface layer in some pedons. If the soils are cultivated, the Ap horizon is black, very dark gray, or very dark brown. The B horizon is 40 to 70 percent clay and 5 to 10 percent sand. The B horizon is dominantly silty clay but ranges to clay or silty clay loam in places. The C horizon is 40 to 60 percent clay.

In Door County, the annual temperature of these soils is a few degrees cooler than the defined range for the series, but this difference does not alter their usefulness and behavior.

Poygan soils are near Kewaunee, Manawa, and Pinconning soils. They are wetter than the well drained Kewaunee and the somewhat poorly drained Manawa soils. Poygan soils are not sandy in the A horizon and upper part of the C horizon, as is characteristic of Pinconning soils.

Po—Poygan silty clay loam. This nearly level soil is in depressions on glacial till plains. Slopes are 0 to 2 percent. Most areas are irregular in shape and are 5 to 100 acres in size.

Included with this soil in mapping are small areas of Manawa soils. Also included are small areas of soils that have a silt loam surface layer and few areas of gently sloping soils.

Runoff is very slow. The hazard of erosion is slight. Wetness is the main limitation of this soil. This soil receives runoff from adjoining areas and is likely to be ponded during wet seasons and after heavy rains. Sur-

face drainage removes excess water rapidly. Deep ditches and subsurface drainage provide internal drainage.

If drained, this soil is suited to corn, small grain, legumes such as red clover, and pasture. Some truck crops are also grown. Tilling at proper moisture conditions helps to maintain good tilth. Undrained areas are used for unimproved pasture, but are better suited to native woodland or to wildlife habitat. Capability unit IIw–1; woodland suitability subclass 2w.

Rock outcrop

Ra—Rock outcrop. This miscellaneous area consists of steep to nearly vertical exposures of dolomite bedrock and stones on escarpments and talus slopes in areas where dolomite is exposed. The areas are more than 90 percent bedrock outcrop. Most areas are long and narrow and are 5 to 120 acres in size. Where soil material is present it ranges widely in thickness and texture. In most places it is less than 12 inches thick and contains dolomite fragments.

Runoff is rapid. Except in crevices, erosion removes soil material as fast as it accumulates.

Areas of Rock outcrop are unsuited to cultivation or pasture. Most areas are barren exposures of dolomite or have a scattered growth of trees where the roots penetrate soil-filled crevices in the dolomite. These areas are best suited to esthetic uses. Capability unit VIIIs–10; woodland suitability subclass 6s.

Rb—Rock outcrop-Namur complex, 6 to 20 percent slopes. This complex consists of well drained to excessively drained, sloping and moderately steep exposures of dolomite bedrock and Namur soils. It is on escarpments and talus slopes in areas of exposed dolomite. Most areas are long and narrow and are 5 to 40 acres in size. This complex is about 75 to 90 percent exposed dolomite bedrock or stones, and as much as 25 percent Namur soils. Rock outcrop and Namur soils are in such small areas or are so intermingled that it was impractical to map them separately. The other soil material in areas of this complex ranges widely in thickness, texture of the surface layer, and sequence of horizons in the subsoil. In some areas, it is more than 12 inches thick. Dolomite fragments are common throughout the soil material.

Runoff is medium or rapid. The hazard of erosion is moderate on Namur soils. The depth of the root zone is generally limited by dolomite bedrock, but some roots extend into crevices in the bedrock.

A few areas are in pasture but most are in woodland. Management is needed to prevent erosion and to maintain plant cover. These soils are better suited to woodland, wildlife habitat, or esthetic uses than to most other uses. This mapping unit is unsuited to farm crops commonly grown in the survey area. Capability unit VIIIs–10; woodland suitability subclasses 6s and 4d.

Rondeau series

The Rondeau series consists of very poorly drained, nearly level organic soils in old glacial lake basins and depressional areas on flood plains. These soils are underlain by marl. The native vegetation is water-tolerant grasses and sedges.

In a representative profile in an undisturbed area, the upper 26 inches is black muck that is about 20 percent recognizable plant fiber if undisturbed. The substratum is light gray, friable marl to a depth of about 60 inches.

The available water capacity is very high. Permeability is moderately rapid in the organic part and slow in the marl substratum. If these soils are not drained, they are saturated with water at a depth of less than 1 foot and the water table limits the depth of the root zone. Natural fertility is low, and the organic-matter content of the surface layer is very high.

Most areas of these soils have not been drained and are in native vegetation. They are better suited to wetland wildlife habitat than to most other uses. A few areas are used for unimproved pasture.

Representative profile of Rondeau muck in an uncultivated field, 1,310 feet south and 330 feet west of the center of sec. 13, T. 26 N., R. 23 E.:

Oa1—0 to 9 inches; black (10YR 2/1) broken face and rubbed sapric material; about 20 percent fibers, less than 10 percent rubbed; moderate medium granular structure; very friable; mainly herbaceous fibers; neutral; abrupt smooth boundary.

Oa2—9 to 21 inches; black (10YR 2/1) broken face and rubbed sapric material; about 20 percent fibers, less than 10 percent rubbed; moderate medium and thick platy structure; friable; mainly herbaceous fibers; neutral; clear wavy boundary.

Oa3—21 to 26 inches; black (10YR 2/1) broken face and rubbed sapric material; about 35 to 40 percent fibers, 10 percent rubbed; massive; friable; mainly herbaceous fibers; neutral; abrupt wavy boundary.

Lca—26 to 50 inches; light gray (5Y 7/1) marl; massive; friable many snail shells mainly less than 5 millimeters in size; strongly effervescent; mildly alkaline.

The organic horizons are neutral or, in some pedons, mildly alkaline. They are 16 to 50 inches thick and are mainly sapric material from herbaceous plants, but in some areas the soil contains thin layers of hemic material less than 10 inches thick. A few woody fragments are in some places. The organic horizons are black, very dark gray, or very dark brown.

Rondeau soils are near Carbondale soils. Rondeau soils have organic deposits 16 to 50 inches thick over marl, whereas Carbondale soils have organic deposits more than 51 inches thick.

Rn—Rondeau muck. This nearly level soil is in depressions on glacial till plains. Slopes are 0 to 2 percent. Most areas are irregular in shape and are 5 to 60 acres in size.

Included with this soil in mapping are small areas of Carbondale and Cathro soils. Also included are small areas of gently sloping soils.

Runoff is very slow. The hazard of erosion is slight. The main limitation of this soil is wetness. Subsidence is a management concern where the water table is lowered too much. This soil is ponded during wet seasons and after heavy rains. Surface drainage helps to

remove excess water rapidly. Deep ditches and subsurface drainage can be used to remove internal water where outlets are available.

Even if drained, this soil is only poorly suited to most crops because of the frost hazard. Undrained areas are better suited to wetland wildlife habitat than to most other uses. Capability unit IIIw–7; woodland suitability subclass 3w.

Rousseau series

The Rousseau series consists of well drained or moderately well drained, gently sloping to very steep soils on old lake border dunes, lake plains, and outwash plains. The native vegetation is red oak, sugar maple, aspen, and white birch.

In a representative profile the surface layer is black fine sand about 3 inches thick. The subsurface layer is grayish brown fine sand about 3 inches thick. The subsoil is about 21 inches thick; it is dark reddish brown, loose fine sand in the upper part and strong brown, loose fine sand in the lower part. The substratum is yellowish brown, loose fine sand to a depth of about 60 inches.

The available water capacity is low, and permeability is rapid. These soils are seasonally saturated at a depth of 2.5 feet or more. Depth of the root zone is more than 6 feet. Natural fertility and organic-matter content of the surface layer are low.

These soils are used mostly for hay, pasture, woodland, and wildlife habitat.

Representative profile of Rousseau fine sand, 6 to 12 percent slopes, in an uncultivated area, 800 feet south and 30 feet east of the northwest corner of sec. 23, T. 29 N., R. 27 E.:

A1—0 to 3 inches; black (10YR 2/1) fine sand; weak medium granular structure; very friable; many roots; medium acid; abrupt smooth boundary.

A2—3 to 6 inches; grayish brown (7.5YR 5/2) fine sand; single grained; loose; many roots; medium acid; clear wavy boundary.

B2ir—6 to 11 inches; dark reddish brown (5YR 3/4) fine sand; single grained; loose; common roots; medium acid; clear wavy boundary.

B3—11 to 27 inches; strong brown (7.5YR 5/6) fine sand; single grained; loose; medium acid; clear wavy boundary.

C—27 to 60 inches; yellowish brown (10YR 5/4) fine sand; single grained; loose; slightly acid.

The solum is 20 to 32 inches thick. It is commonly medium acid but ranges to strongly acid in some pedons. The C horizon is medium acid or slightly acid. The profile is dominantly fine sand throughout. The A1 horizon is black or very dark gray. The Bir horizon is dark brown, brown, dark reddish brown, or reddish brown. Where present, the B horizon is strong brown, yellowish red, or reddish yellow. The C horizon is brown, pale brown, yellowish brown, light brown, or strong brown. Content of coarse fragments is less than 5 percent, by volume.

Rousseau soils are near Deford, Manistee, and Wainola soils. They are better drained than Wainola and Deford soils. They do not have the clayey texture in the lower part of the B horizon and in the C horizon that is characteristic of Manistee soils.

RoB—Rousseau fine sand, 2 to 6 percent slopes. This gently sloping soil is on sandy outwash plains and lake plains. Most areas are irregular in shape and are 10 to 200 acres in size.

This soil has a profile similar to the one described as representative of the series, but it has a thicker surface layer and more distinct horizon development. This soil is also less susceptible to soil blowing than the representative soil.

Included with this soil in mapping are small areas of Manistee and Wainola soils. Also included are small areas of sloping Rousseau fine sand and areas of gently sloping and sloping Rousseau-Shawano fine sands.

Runoff is slow. The hazard of erosion is moderate. Droughtiness is the main limitation of this soil.

Most areas of this soil are used for hay, unimproved pasture, native woodland, and wildlife habitat. Management is needed to supply regular additions of organic matter and to conserve moisture. This soil is moderately well suited to crops commonly grown in the county. Capability unit IIIs–3; woodland suitability subclass 3s.

RoC—Rousseau fine sand, 6 to 12 percent slopes. This sloping soil is on sandy outwash plains and lake plains. Most areas are irregular in shape and are 10 to 200 acres in size. This soil has the profile described as representative of the series (fig. 5).

Included with this soil in mapping are small areas of Wainola soils. Also included are small areas of gently sloping Rousseau soils and areas of gently sloping and sloping Rousseau-Shawano fine sands.

Runoff is slow. The hazard of erosion is slight. A moderate hazard of soil blowing is the main limitation of this soil. Droughtiness limits crop growth.

This soil is mostly used for permanent hay, unimproved pasture, native woodland, and wildlife habitat. Management is needed to supply regular additions of organic matter and to conserve moisture. This soil is moderately well suited to crops commonly grown in the county. Capability unit IIIe–7; woodland suitability subclass 3s.

RpC—Rousseau-Shawano fine sands, 2 to 12 percent slopes. These gently sloping and sloping soils are on sandy outwash plains and ridges. Most areas are elongated and are 10 to 200 acres in size. This complex is about 75 percent Rousseau soils and 25 percent Shawano soils. The Rousseau and Shawano soils are in such small areas and are so intermingled that it was impractical to map them separately. The Rousseau soils have a profile similar to the one described as representative of the Rousseau series, but the surface layer has more sand, less natural fertility, and lower organic-matter content. The Shawano soil has the profile described as representative of the series. It is in unvegetated depressions and on hummocks. It has lost a considerable amount of soil material by soil blowing.

Included with these soils in mapping are small areas of Wainola soils and areas of moderately steep or steep Rousseau soils.

Runoff is slow. The hazard of erosion is moderate.

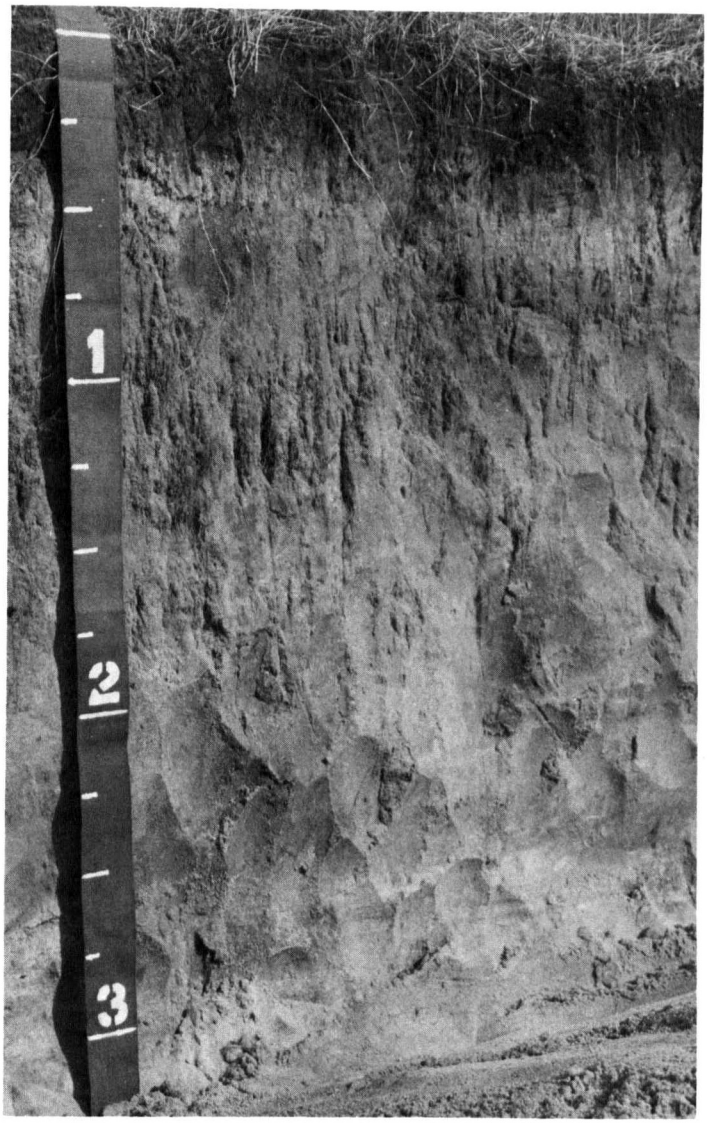

Figure 5.—**Typical profile of a Rousseau fine sand, 6 to 12 percent slopes.**

Soil blowing is a hazard. Low available water capacity is the main limitation of these soils.

Most areas of this complex are in unimproved pasture or native woodland. Some areas are in pine trees. Management is needed to maintain plant cover, conserve moisture, and control soil blowing. These soils are generally unsuited to cultivated crops. Capability unit VIs–3; woodland suitability subclasses 3s and 6s.

RpD—Rousseau-Shawano fine sands, 12 to 35 percent slopes. These moderately steep to very steep soils are on sandy outwash ridges. Most areas are elongated and are 10 to 200 acres in size. This complex is about 65 percent Rousseau soils and 35 percent Shawano soils (fig. 6). The Rousseau and Shawano soils are in such small areas and are so intermingled that it was not practical to map them separately. The Rousseau soils have a profile similar to the one described as representative of the series, but the surface layer has more sand, less natural fertility, and lower organic-matter content. The Shawano soil is in unvegetated depressions and on hummocks. It has lost a considerable amount of material by soil blowing.

Included with these soils in mapping are small areas of gently sloping or sloping Rousseau soils.

Runoff is slow. The hazard of erosion is moderate. Low available water capacity, slope, and the hazard of soil blowing are the main limitations of these soils.

Most areas of this complex are in unimproved pasture or native woodland. Some areas are in pine trees. Management is needed to maintain plant cover, conserve moisture, and control soil blowing. These soils are unsuited to cultivated crops. Capability unit VIIs–3; woodland suitability subclasses 3s and 6s.

RrB—Rousseau-Deford fine sands, 2 to 6 percent slopes. These nearly level and gently sloping soils are on low ridges and in swales on sandy outwash plains and lake plains. Most areas are elongated and are 50 to 300 acres in size. This complex is about 40 percent Rousseau soils, 40 percent Deford soils, and 20 percent Markey and Wainola soils. The Rousseau soils are mostly gently sloping. The Deford soils are mostly nearly level.

Included with these soils in mapping are small areas of sloping Rousseau soils.

Runoff is slow. The hazard of erosion is slight. Soil blowing is a hazard. The low available water capacity of the Rousseau soils and the wetness of the Deford soils are the main limitations. Surface drainage removes excess water on Deford soils. Deep ditches provide internal drainage where outlets are available.

Most areas of this complex are in native woodland or wildlife habitat. Management is needed on Rousseau soils to supply regular additions of organic matter and to conserve moisture. These soils are generally poorly suited to crops commonly grown in the county. Capability unit IVw–5; woodland suitability subclasses 3s and 4w.

Saprists

Sa—Saprists. These soils are in depressions where drainage water accumulates. Saprists areas occur intermittently throughout the survey area, particularly along the shorelines of Green Bay and Lake Michigan. Slopes are 0 to 2 percent. These areas occupy shallow lakes and ponds that are dry during years with less than normal rainfall. Most areas, however, remain wet all year. It is not practical to drain most areas because of their low position on the landscape and the lack of suitable outlets.

Saprists are unsuited to any type of crop or wood production. They provide good habitat for waterfowl such as ducks and geese and for fur-bearing animals such as muskrat and mink. Cattails, rushes, sedges, willows, and other water-tolerant plants grow abundantly and provide wildlife habitat. Capability unit VIIIw–15; woodland suitability subclass 6w.

Shawano series

The Shawano series consists of excessively drained, gently sloping to very steep soils on old lake border dunes, lake plains, and outwash plains. The native

Figure 6.—**Typical area of Rousseau-Shawano fine sands, 12 to 35 percent slopes, near Clark Lake.**

vegetation is red oak, sugar maple, white birch, and white-cedar.

In a representative profile the surface layer is very dark grayish brown fine sand about 4 inches thick. The subsurface layer is pale brown fine sand about 3 inches thick. The subsoil is about 17 inches thick; it is strong brown, loose fine sand in the upper part and reddish yellow, loose fine sand in the lower part. The substratum is light yellowish brown fine and medium sand to a depth of about 60 inches.

The available water capacity is low, and permeability is rapid. These soils are seasonally saturated at a depth of 6 feet or more. Depth of the root zone is more than 6 feet. Natural fertility and the organic-matter content of the surface layer are very low.

In Door County, Shawano soils are mapped only in complexes with Rousseau soils.

Representative profile of Shawano fine sand in an area of Rousseau-Shawano fine sands, 2 to 12 percent slopes, in a wooded area, 600 feet south and 1,100 feet west of the northeast corner of sec. 12, T. 29 N., R. 27 E.:

A1—0 to 4 inches; very dark grayish brown (10YR 3/2) fine sand; weak medium granular structure; very friable; few fine fibrous roots; slightly acid; clear wavy boundary.

A2—4 to 7 inches; pale brown (10YR 6/3) fine sand; single grained; loose; few fine fibrous roots; medium acid; clear wavy boundary.

B2—7 to 12 inches; strong brown (7.5YR 5/6) fine sand; single grained; loose; few fine fibrous roots; medium acid; clear irregular boundary.

B3—12 to 24 inches; reddish yellow (7.5YR 6/6) fine sand; single grained; loose; neutral; gradual wavy boundary.

C—24 to 60 inches; light yellowish brown (10YR 6/4) fine and medium sand; single grained; loose; mildly alkaline.

The solum is 18 to 36 inches thick, and depth to free carbonates is 60 inches or more. The solum is commonly medium acid and or slightly acid but ranges to strongly acid in some pedons. Reaction of the transitional B3 horizon ranges to neutral in some places. Undisturbed areas have an A1 horizon that is dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2) fine sand

about 1 to 4 inches thick. In areas that have active soil blowing, some or all of the horizons are missing, or several inches of sandy overburden cover the A1 horizon. In some places, the A2 horizon is absent. The B and C horizons are dominantly fine sand but range to very fine sand. The profile is less than 5 percent coarse fragments throughout.

Shawano soils are near Rousseau soils and have formed in similar materials. Shawano soils lack the distinct subsoil layer of iron accumulation that is present in Rousseau soils.

Sisson series

The Sisson series consists of well drained, nearly level to sloping soils on old lake plains. The native vegetation is northern hardwoods, primarily sugar maple and red oak.

In a representative profile the surface layer is dark grayish brown fine sandy loam about 8 inches thick. The subsurface layer is brown loamy fine sand about 2 inches thick. The next layer is mixed brown loamy fine sand and dark brown fine sandy loam about 3 inches thick. The subsoil is about 20 inches thick. It is dark brown, friable fine sandy loam in the upper part; dark brown, firm loam in the middle part; and brown, friable fine sandy loam in the lower part. The substratum is brown, friable, stratified silt, very fine sand, and fine sand to a depth of about 60 inches.

The available water capacity is high, and pemeability is moderate. These soils are seasonally saturated at a depth of 6 feet or more. Depth of the root zone is more than 6 feet. Natural fertility is medium, and the organic-matter content of the surface layer is moderate.

Most areas of these soils are used for all farm crops commonly grown in the county.

Representative profile of Sisson fine sandy loam, 2 to 8 percent slopes, in a cultivated field, 1,040 feet south and 900 feet west of the northeast corner of the SE¼ sec. 21, T. 26 N., R. 23 E.:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) fine sandy loam; weak medium granular structure; friable; slightly acid; abrupt smooth boundary.

A2—8 to 10 inches; brown (10YR 5/3) loamy fine sand; weak thin platy structure; very friable; slightly acid; abrupt wavy boundary.

A&B—10 to 13 inches; brown (10YR 5/3) loamy fine sand (A2); weak thin platy structure that interfingers into and surrounds some peds of dark brown (7.5YR 4/4) fine sandy loam (B2); weak fine subangular blocky structure; friable; slightly acid; clear wavy boundary.

B&A—13 to 16 inches; dark brown (7.5YR 4/4) fine sandy loam (B2); weak fine subangular blocky structure that is interfingered by brown (10YR 5/3) loamy fine sand (A2); weak fine subangular blocky structure; friable; slightly acid; clear wavy boundary.

B21t—16 to 23 inches; dark brown (7.5YR 4/4) heavy fine sandy loam; weak medium subangular blocky structure; friable; slightly acid; gradual wavy boundary.

B22t—23 to 27 inches; dark brown (7.5YR 4/4) loam; moderate medium subangular blocky structure; firm; patchy clay films on ped faces and in root channels; slightly acid; clear wavy boundary.

B3—27 to 33 inches; brown (7.5YR 5/4) fine sandy loam; weak fine subangular blocky structure; friable; neutral; abrupt wavy boundary.

C—33 to 60 inches; brown (10YR 5/3) stratified silt; very fine sand and fine sand; massive; friable; slightly effervescent; mildly alkaline.

The solum is 24 to 40 inches thick. It is slightly acid to neutral but ranges to mildly alkaline in some pedons. The C horizon is commonly mildly alkaline but ranges to moderately alkaline. Uncultivated areas have a very dark grayish brown A1 horizon 2 to 4 inches thick. The A horizon is dominantly fine sandy loam, but the A2 horizon is loamy fine sand in some places. In uneroded areas there is an A2 horizon 2 to 6 inches thick. In some pedons the A&B and B&A horizons have tongues of A2 material surrounding columnarlike peds of the Bt horizon or surrounding small isolated remnants of the Bt horizon. The B horizon is dark brown, brown, yellowish brown, or dark yellowish brown. It is commonly fine sandy loam or very fine sandy loam but ranges to silt loam or loam in some pedons. The C horizon is stratified silt and very fine sand, but some pedons have thin lenses of fine sand or silty clay loam or both.

In Door County, these soils have slightly less clay, more interfingering of the A2 horizon into the B horizon, and an annual temperature a few degrees cooler than the defined range for the series. These differences do not alter their usefulness and behavior.

Sisson soils are near Boyer and Yahara soils. They have a finer textured B horizon than Boyer soils and are better drained than the somewhat poorly drained Yahara soils.

SnA—Sisson fine sandy loam, 0 to 2 percent slopes. This nearly level soil is on old glacial lake plains. Most areas are irregular in shape and are 10 to 100 acres in size.

This soil has a profile similar to the one described as representative of the series, but it is less susceptible to erosion and generally produces higher yields.

Included with this soil in mapping are small areas of Yahara soils. Also included are small areas of gently sloping Sisson fine sandy loam, and small areas of soils that have a silt loam surface layer or a fine sandy loam subsoil.

Runoff is slow. The hazard of erosion is slight. This soil has few limitations for farming.

Most areas of this soil are used for corn, small grain, and legumes. Some truck crops are also grown. Management practices such as the use of green manure crops and barnyard manure help to maintain good tilth and organic-matter content and sustain crop yields. This soil is well suited to all crops commonly grown in the county. Capability unit I–4; woodland suitability subclass 1o.

SnB—Sisson fine sandy loam, 2 to 8 percent slopes.

This gently sloping and sloping soil is on old glacial lake plains. Most areas are irregular in shape and are 10 to 150 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Yahara soils. Also included are small areas of nearly level and sloping eroded Sisson fine sandy loams and small areas of soils that have a silt loam surface layer or fine sandy loam subsoil.

Runoff is slow. The hazard of erosion is slight, and it is the main limitation of this soil.

Most areas of this soil are used for corn, small grain, and legumes. Some truck crops are also grown. Management is needed to prevent water erosion and to maintain organic-matter content and good tilth. Practices such as the use of green manure crops and barnyard manure are necessary to sustain crop yields. If properly managed, this soil is well suited to all crops commonly grown in the county. Capability unit IIe–1; woodland suitability subclass 1o.

Solona series

The Solona series consists of somewhat poorly drained, nearly level soils in depressions and drainageways on glacial till plains. The native vegetation is American elm, northern white-cedar, and white ash.

In a representative profile the surface layer is very dark grayish brown loam about 9 inches thick. The subsurface layer is brown loam about 3 inches thick. The subsoil is about 15 inches thick and is mottled; it is yellowish brown, friable silt loam in the upper part and reddish brown, friable loam in the lower part. The substratum is mottled, light brown, friable sandy loam to a depth of about 60 inches.

The available water capacity and permeability are moderate. These soils are seasonally saturated at a depth of 1 to 3 feet, unless they are drained. If these soils are not drained, the depth of the root zone is limited by the water table. Natural fertility is medium, and the organic-matter content of the surface layer is moderate.

If drained, these soils are used for pasture or for general farm crops commonly grown in the county. Undrained areas provide good wetland wildlife habitat. Some undrained areas are used for unimproved pasture.

Representative profile of Solona loam, 0 to 3 percent slopes, in a cultivated field, 1,020 feet west and 20 feet south of the northeast corner of the SE¼ sec. 13, T. 31 N., R. 27 E.:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loam, light brownish gray (10YR 6/2) dry; moderate medium subangular blocky structure; friable; many roots; mildly alkaline; abrupt smooth boundary.

A2—9 to 12 inches; brown (10YR 5/3) loam; weak medium subangular blocky structure; friable; many roots; neutral; clear wavy boundary.

B1—12 to 18 inches; yellowish brown (10YR 5/4) silt loam; few medium distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; friable; many roots; mildly alkaline; gradual wavy boundary.

B2t—18 to 27 inches; reddish brown (5YR 4/4) loam; common medium prominent yellowish brown (10YR 5/6) and light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; thin patchy clay films in pores; friable; mildly alkaline; gradual smooth boundary.

C—27 to 60 inches; light brown (7.5YR 6/4) sandy loam; common medium distinct strong brown (7.5YR 5/6) and light gray (10YR 7/2) mottles; weak medium subangular blocky structure; friable; strongly effervescent; moderately alkaline.

The solum is 24 to 30 inches thick and is neutral to mildly alkaline. The C horizon is commonly moderately alkaline but ranges to mildly alkaline in some pedons. The surface layer is dominantly loam. The A1 or Ap horizon is very dark grayish brown, very dark brown, or dark brown. The A2 horizon is dark grayish brown, brown, or dark yellowish brown. The B1 horizon is loam, sandy loam, or silt loam. The Bt horizon is heavy sandy loam, loam, or clay loam, and is dark brown, brown, or reddish brown. The C horizon is brown, dark brown, or reddish brown, and is loam or sandy loam. Content of coarse fragments in the C horizon is as much as 20 percent, by volume.

In Door County these soils are slightly more acid than the defined range for the series, but this difference does not alter their usefulness and behavior.

Solona soils are near Angelica, Bonduel, and Emmet soils. They are better drained than Angelica soils and do not have the dolomite bedrock that underlies Bonduel soils. Solona soils are wetter than the well drained Emmet soils.

SoA—Solona loam, 0 to 3 percent slopes. This nearly level and gently sloping soil is in drainageways and depressions on glacial till plains. Most areas in drainageways are elongated and areas in depressions are irregular in shape. Areas are 3 to 100 acres in size.

Included with this soil in mapping are small areas of Emmet and Angelica soils. Also included are some small areas of soils that have a sandy loam surface layer.

Runoff is slow. The hazard of erosion is slight. Wetness is the main limitation of this soil. This soil receives runoff from adjoining areas and is likely to be ponded for brief periods during wet seasons and after heavy rains. Surface drainage removes excess water rapidly. Deep ditches and field tile provide internal drainage.

If drained, this soil is suited to corn, small grain, legumes such as red clover, and pasture. Undrained areas are used for unimproved pasture, but are better suited to wetland wildlife habitat. Capability unit IIw–2; woodland suitability subclass 2o.

Suamico series

The Suamico series consists of very poorly drained, nearly level, organic soils in old glacial lake basins and

depressions. These soils are underlain by clayey glacial till. The native vegetation is northern white-cedar, willow, white birch, alder, and redosier dogwood.

In a representative profile the upper 33 inches is black muck that contains about 10 percent recognizable plant fibers if undisturbed. The substratum is mottled gray and brown, plastic silty clay to a depth of about 60 inches.

The available water capacity is very high. Permeability is moderately rapid in the organic layer and slow in the substratum. These soils are saturated at a depth of less than 1 foot, unless they are drained. If they are not drained, the depth of the root zone is limited by the water table. Natural fertility is low, and organic-matter content of the surface layer is very high.

If drained, these soils are used for most general farm crops commonly grown in the county. Undrained areas provide very good wetland wildlife habitat. A few areas are used for unimproved pasture.

Representative profile of Suamico muck in a wooded area, 700 feet east and 200 feet north of the center of sec. 32, T. 26 N., R. 24 E.:

Oa1–0 to 7 inches; black (10YR 2/1) broken face and rubbed sapric material; about 10 percent fibers, less than 5 percent rubbed; weak medium subangular blocky structure parting to fine granular; very friable; primarily herbaceous fibers; neutral; clear wavy boundary.

Oa2—7 to 33 inches; black (10YR 2/1) broken face and rubbed sapric material; about 10 percent fibers, less than 5 percent rubbed; weak medium platy structure parting to moderate fine and medium granular; very friable; primarily herbaceous fibers; neutral; abrupt smooth boundary.

IIC1g—33 to 45 inches; gray (10YR 5/1) silty clay; common medium distinct yellowish brown (10YR 5/4) mottles; massive; plastic; strongly effervescent; moderately alkaline; clear smooth boundary.

IIC2g—45 to 60 inches; brown (7.5YR 5/2) silty clay; few medium faint light brown (7.5YR 6/4) mottles; massive; plastic; strongly effervescent; moderately alkaline.

The organic horizons are 16 to 50 inches thick in undrained areas. They are generally neutral, but in some pedons the reaction ranges to slightly acid. The organic horizons are very dark gray or black and are primarily sapric material from herbaceous plants. A few woody fragments are in some pedons. The substratum is commonly silty clay but ranges to clay or heavy clay loam in some places. Reaction is dominantly moderately acid but ranges to neutral.

Suamico soils are near Carbondale and Cathro soils and are now classified within the range of the Cathro series. Suamico and Cathro soils both formed in organic deposits 16 to 50 inches thick; Suamico soils over a clayey substratum, and Cathro soils over a loamy substratum. Carbondale soils formed in organic deposits more than 51 inches thick.

Su—Suamico muck. This nearly level soil is in old glacial lake basins and in depressions. Slopes are 0 to 2 percent. Most areas are irregular in shape and are 5 to 100 acres in size.

Included with this soil in mapping are small areas of Carbondale and Cathro soils. Also included are small, gently sloping areas of Suamico muck.

Runoff is slow. The hazard of erosion is very slight. Wetness is the main limitation of this soil. Subsidence is a management concern if the water table is lowered too much. This soil is likely to be ponded during wet seasons and after heavy rains. Surface drainage removes excess water rapidly. Deep ditches and subsurface drainage provide internal drainage.

Even if drained, this soil is poorly suited to crops commonly grown in the county because of the frost hazard. In places, undrained areas are used for unimproved pasture, but are better suited to wetland wildlife habitat than to most other uses. Capability unit IVw–7; woodland suitability subclass 3w.

Summerville series

The Summerville series consists of well drained, nearly level to moderately steep soils on glacial till plains where the underlying dolomite bedrock is at a depth of 10 to 20 inches. The native vegetation is northern hardwoods, primarily sugar maple and red oak.

In a representative profile the surface layer is very dark grayish brown loam about 5 inches thick. The subsurface layer is grayish brown loam about 7 inches thick. The subsoil is dark brown, firm loam about 3 inches thick. Dolomite bedrock is at a depth of about 15 inches.

The available water capacity is very low, and permeability is moderate. These soils are seasonally saturated at a depth of 6 feet or more. The depth of the root zone is limited by the dolomite bedrock. Natural fertility is medium or low, and the organic-matter content of the surface layer is moderate.

Many areas of these soils are used for all farm crops commonly grown in the county. Some areas also remain in native woodland.

Representative profile of Summerville loam, 2 to 6 percent slopes, in a cultivated field, 780 feet east and 400 feet north of the southwest corner of the SE¼ sec. 29, T. 29 N., R. 26 E.:

Ap—0 to 5 inches; very dark grayish brown (10YR 3/2) loam; weak medium subangular blocky structure parting to moderate medium granular; friable; many roots; neutral; abrupt smooth boundary.

A2—5 to 12 inches; grayish brown (10YR 5/2) loam; moderate medium subangular blocky structure; friable; common roots; slightly acid; gradual wavy boundary.

B2ir—12 to 15 inches; dark brown (7.5YR 4/4) loam; moderate medium subangular blocky structure; firm; common roots; neutral; abrupt wavy boundary.

R—15 inches; light gray (10YR 7/2) consolidated dolomite bedrock.

The solum is slightly acid to neutral. Depth to dolomite bedrock is 10 to 20 inches. The Ap or A1 horizon is very dark brown, very dark gray, or very dark

grayish brown loam or sandy loam. Where present, the Bir horizon is dark brown, brown, or reddish brown loam or sandy loam.

Summerville soils are near Bonduel Shallow Variant, Longrie, and Namur soils. They are not so wet as Bonduel Shallow Variant soils. Summerville soils are thinner over dolomite than Longrie soils and mostly thicker over dolomite than Namur soils.

SvA—Summerville loam, 0 to 2 percent slopes. This nearly level soil is on glacial till plains that are underlain by dolomite bedrock. Most areas are irregular in shape and are 5 to 200 acres in size.

This soil has a profile similar to the one described as representative of the series, but it has a thicker surface layer. This soil also is less susceptible to erosion.

Included with this soil in mapping are small areas of Bonduel Shallow Variant, Longrie, and Namur Variant soils. Also included are areas of gently sloping Summerville loam. In some places, there are dolomite or shale bedrock outcrops.

Runoff is slow. The hazard of erosion is slight. Droughtiness is the main limitation of this soil.

Some areas of this soil are used for corn, small grain, legumes, and pasture. Management practices such as minimum tillage and the use of green manure crops and barnyard manure are necessary to sustain crop yields. If properly managed, this soil is moderately well suited to most crops commonly grown in the county. Many areas remain in native woodland. Capability unit IIIs–8; woodland suitability subclass 3d.

SvB—Summerville loam, 2 to 6 percent slopes. This gently sloping soil is on glacial till plains that are underlain by dolomite bedrock. Most areas are irregular in shape and are 5 to 200 acres in size. This soil has the profile described as representative of the series (fig. 7).

Included with this soil in mapping are small areas of Longrie, Namur, and Kolberg Variant soils. Also included are small areas of nearly level and sloping Summerville loam and a few dolomite bedrock outcrops.

Runoff is medium. The hazard of erosion is moderate, and it is the main limitation of this soil.

Some areas of this soil are used for corn, small grain, legumes, and pasture. Management practices such as protection from erosion and the use of green manure crops and barnyard manure are necessary to sustain crop yields. If properly managed, this soil is moderately well suited to most crops grown in the county. Many areas remain in native woodland. Capability unit IIIe–3; woodland suitability subclass 3d.

SvC—Summerville loam, 6 to 12 percent slopes. This sloping soil is on glacial till plains that are underlain by dolomite bedrock. Most areas are irregular in shape and are 5 to 150 acres in size.

This soil has a profile similar to the one described as representative of the series, but it has a thinner surface layer. This soil also is more susceptible to erosion and has more surface stones and dolomite bedrock outcrops.

Included with this soil in mapping are small areas of Longrie, Namur, and Kolberg Variant soils. Also included are small areas of gently sloping and moderately steep Summerville loam and dolomite outcrops.

Runoff is medium. The hazard of erosion is moderate, and it is the main limitation of this soil.

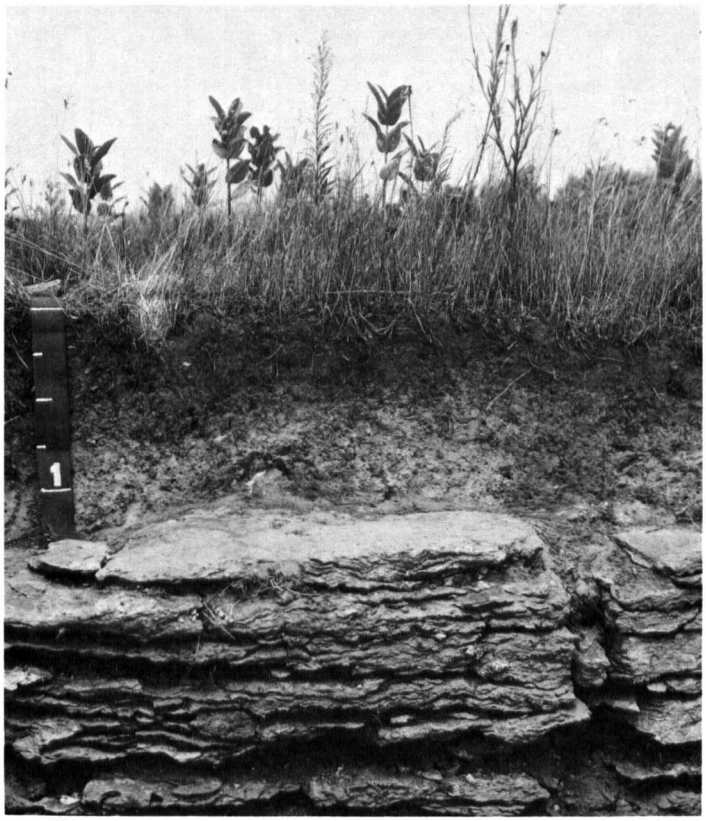

Figure 7.—Typical profile of Summerville loam, 2 to 6 percent slopes.

Most areas of this soil are in native woodland. Some areas are used for corn, small grain, legumes, and pasture. Management practices such as the use of green manure crops and barnyard manure are necessary to sustain crop yields. Management is needed to maintain plant cover, prevent erosion, and supply organic matter. This soil is poorly suited to crops commonly grown in the county. Capability unit IVe–3; woodland suitability subclass 3d.

SvD—Summerville loam, 12 to 20 percent slopes. This moderately steep soil is on glacial till plains that are underlain by dolomite bedrock. Most areas are irregular in shape and are 5 to 100 acres in size.

This soil has a profile similar to the one described as representative of the series, but it has a thinner surface layer. This soil is also more susceptible to erosion and has more surface stones and dolomite bedrock outcrops.

Included with this soil in mapping are small areas of Namur soils. Also included are small areas of sloping and steep Summerville loams and some dolomite outcrops.

Runoff is rapid. The hazard of erosion is severe, and it is the main limitation of this soil.

Most areas of this soil are used for hay, unimproved pasture, native woodland, or wildlife habitat. Management is needed to supply regular additions of organic matter and to conserve moisture. This soil is generally unsuited to farm crops commonly grown in the county. Capability unit VIe–3; woodland suitability subclass 3d.

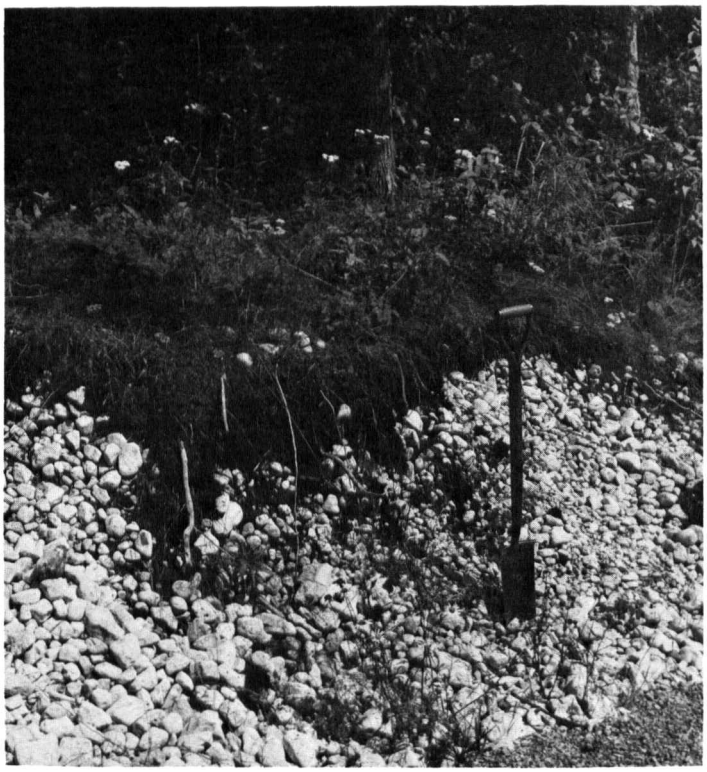

Figure 8.—Washed gravel and cobble ridges located on old glacial lake beaches.

Udipsamments

Ud—Udipsamments. These areas consist of well drained to excessively drained, gently sloping and sloping beach deposits along major lakes. Slopes are mainly 2 to 12 percent. Some areas are moderately steep and steep. The deposits have very little or no evidence of soil profile development. Adjacent to the present lakes and as far as 100 feet from them there is little, if any, vegetation. At greater distances from the lakes, the native vegetation is mainly white birch, northern white-cedar, and drought-tolerant grasses. Most areas are long and narrow.

Due to the very droughty nature of these sandy deposits, soil blowing, and erosion by wave action, these areas are unsuited to and are not used for cultivated crops or pasture. They are used extensively for recreation and in a few places for homesites. Capability unit VIIs–9; woodland suitability subclass 6s.

Udorthents

Uo—Udorthents, cobbly. These areas consist of excessively drained, gently sloping and sloping beach deposits along major lakes. These deposits have very little or no evidence of soil profile development (fig. 8). They consist of coarse gravel and stones and slabs of dolomite as much as 20 inches long. Slopes are 2 to 12 percent. Adjacent to the present lakes, and as far as 100 feet from them there is little, if any, vegetation. At greater distances from the lakes, the native vegetation is mainly white birch, northern white-cedar, and drought-tolerant grasses. Most areas are long and narrow.

Due to the very droughty nature of these deposits, soil blowing, and erosion by wave action, these areas are unsuited to and are not used for cultivated crops or pasture. They are used extensively for recreation and in a few places for homesites. Capability unit VIIs–9; woodland suitability subclass 6s.

Wainola series

The Wainola series consists of somewhat poorly drained, nearly level soils on sandy lacustrine and outwash plains. The native vegetation is aspen, willow, and black spruce.

In a representative profile the surface layer is black loamy fine sand about 5 inches thick. The subsurface layer is grayish brown fine sand about 8 inches thick. The subsoil is about 17 inches thick and is mottled; it is dark reddish brown, loose fine sand in the upper part and dark brown, loose fine sand in the lower part. The substratum is mottled, yellowish brown, loose fine sand to a depth of about 60 inches.

The available water capacity is low, and permeability is rapid. These soils are seasonally saturated at a depth of 1 to 2 feet, unless they are drained. If these soils are not drained, the depth of the root zone is limited by the water table. Natural fertility and the organic-matter content of the surface layer are low.

If drained, most areas of these soils are used for pasture or general farm crops commonly grown in the county. Undrained areas are used for unimproved pasture, woodland, or wetland wildlife habitat.

Representative profile of Wainola loamy fine sand in a wooded area, 740 feet east and 10 feet south of the center of sec. 23, T. 32 N., R. 28 E.:

A1—0 to 5 inches; black (10YR 2/1) loamy fine sand; weak fine granular structure; very friable; many roots; medium acid; abrupt smooth boundary.

A2—5 to 13 inches; grayish brown (10YR 5/2) fine sand; single grained; loose; common roots; slightly acid; abrupt smooth boundary.

B21ir—13 to 24 inches; dark reddish brown (5YR 3/4) fine sand; common medium distinct strong brown (7.5YR 5/6) mottles; single grained; loose; common roots; slightly acid; clear wavy boundary.

B22ir—24 to 30 inches; dark brown (7.5YR 4/4) fine sand; common medium distinct yellowish brown (10YR 5/6) mottles; single grained; loose; slightly acid; abrupt smooth boundary.

C—30 to 60 inches; yellowish brown (10YR 5/4) fine sand; few medium distinct brownish yellow (10YR 6/6) mottles; single grained; loose; slightly acid.

The solum is 20 to 34 inches thick and is slightly acid to medium acid. In cultivated areas, the surface layer is 6 to 8 inches thick. In uncultivated areas, the A1 horizon is 3 to 5 inches thick and is black, very dark brown, very dark gray, or very dark grayish brown. The B horizon is dark brown, dark reddish brown, dark yellowish brown, or reddish brown. The C horizon

is brown, yellowish brown, pale brown, or very pale brown. Coarse fragments are less than 5 percent, by volume. The B and C horizons are commonly fine sand but range to loamy fine sand in some pedons.

Wainola soils are near Deford, Rousseau, and Yahara soils. They form a drainage sequence with the poorly drained Deford soils and the well drained Rousseau soils. Wainola soils do not have the stratified silt and fine sand C horizon that Yahara soils have.

Wa—Wainola loamy fine sand. This nearly level soil is on sandy lacustrine and outwash plains. Slopes are 0 to 2 percent. Most areas are irregular in shape and are 5 to 200 acres in size.

Included with this soil in mapping are small areas of Deford and Rousseau soils. Some small areas have a fine sandy loam surface layer.

Runoff is slow. The hazard of erosion is slight. Wetness is the main limitation of this soil. This soil receives runoff from adjoining areas and is likely to be ponded during wet seasons and after heavy rains. Surface drainage removes excess surface water rapidly. Deep ditches provide internal drainage.

Even if drained, this soil is poorly suited to most crops commonly grown in the county because of the frost hazard. Undrained areas are used for unimproved pasture, woodland, or wetland wildlife habitat. Capability unit IVw–5; woodland suitability subclass 3o.

Yahara series

The Yahara series consists of somewhat poorly drained, nearly level and gently sloping soils on old glacial lake plains. The native vegetation is American elm, northern white-cedar, and white ash.

In a representative profile the surface layer is black fine sandy loam about 8 inches thick. The subsoil is about 13 inches thick and is mottled. It is brown, friable fine sandy loam in the upper part; yellowish brown, friable silt loam in the middle part; and brown, loose medium sand in the lower part. The substratum is yellowish brown, friable stratified silt and fine sand in the upper part; brown, firm silty clay loam in the middle part; and grayish brown, loose, very fine sand in the lower part to a depth of about 60 inches. There are mottles in the substratum.

The available water capacity is high, and permeability is moderate. These soils are seasonally saturated at a depth of 1 to 3 feet, unless they are drained. If these soils are not drained, the depth of the root zone is limited by the water table. Natural fertility is medium, and the organic-matter content of the surface layer is moderate.

If drained, most areas of these soils are used for pasture or general farm crops commonly grown in the county. Undrained areas are used for unimproved pasture, woodland, or wetland wildlife habitat.

Representative profile of Yahara fine sandy loam, 0 to 3 percent slopes, in an uncultivated area, 640 feet west and 50 feet north of the southeast corner of the SW¼ sec. 21, T. 26 N., R. 23 E.:

A1—0 to 8 inches; black (10YR 2/1) fine sandy loam; weak fine subangular blocky structure; very friable; common roots; neutral; abrupt smooth boundary.

B1—8 to 9 inches; brown (10YR 4/3) fine sandy loam; few medium prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; neutral; clear wavy boundary.

B2—9 to 17 inches; yellowish brown (10YR 5/4) silt loam; common medium distinct light brownish gray (10YR 6/2) and many coarse prominent yellowish brown (10YR 5/8) mottles; weak medium subangular blocky structure; friable; neutral; abrupt wavy boundary.

B3—17 to 21 inches; brown (10YR 5/3) medium sand; few medium faint light brownish gray (10YR 6/2) and many medium prominent yellowish brown (10YR 5/6) mottles; single grained; loose; neutral; abrupt smooth boundary.

C1—21 to 40 inches; yellowish brown (10YR 5/4) silt with thin strata of fine sand; common medium faint brown (7.5YR 4/4) and common medium distinct yellowish brown (10YR 5/6) mottles; weak medium platy structure; friable; slightly effervescent; mildly alkaline; abrupt wavy boundary.

C2—40 to 48 inches; brown (7.5YR 5/4) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; slightly effervescent; mildly alkaline; abrupt wavy boundary.

C3—48 to 60 inches; grayish brown (10YR 5/2) very fine sand; few fine prominent brownish yellow (10YR 6/6) mottles; single grained; loose; strongly effervescent; moderately alkaline.

The solum is 20 to 40 inches thick. The solum is commonly neutral but in some pedons ranges to mildly alkaline. The C horizon is mildly alkaline or moderately alkaline. The B horizon is brown, yellowish brown, or light yellowish brown, and is mainly fine sandy loam and silt loam. The C horizon is mainly stratified silt and very fine sand but has thin layers of fine or medium sand, silty clay loam, or silty clay.

In Door County, the annual temperature of these soils is a few degrees cooler than the defined range for the series, but this difference does not alter their usefulness and behavior.

Yahara soils are near Sisson, Wainola, and Yahara Variant soils. They form a drainage sequence with the poorly drained Yahara Variant soils and the well drained Sisson soils. Yahara soils contain more silt and clay and less sand than Wainola soils, which are formed in sandy sediment.

YaA—Yahara fine sandy loam, 0 to 3 percent slopes. This nearly level and gently sloping soil is on glacial lake plains. Most areas are irregular in shape and are 5 to 250 acres in size.

Included with this soil in mapping are small areas of Sisson and Yahara Variant soils and soils that have a silt loam surface layer. Also included are small areas of soils that are underlain by sandy loam, loam, or clay loam glacial till at a depth of 36 to 60 inches.

Runoff is slow. The hazard of erosion is slight. Wetness is the main limitation of this soil. This soil receives runoff from adjoining areas and is likely to be ponded

during wet seasons and after heavy rains. Surface drainage removes excess water rapidly. Deep ditches provide internal drainage. Where field tiles are used, silt and fine sand enter the tile lines unless precautions are taken to prevent their entry.

If drained, this soil is suited to corn, small grain, legumes such as red clover, and pasture. Some truck crops are also grown. Undrained areas are used for unimproved pasture, but are better suited to woodland or wetland wildlife habitat. Capability unit IIw–4; woodland suitability subclass 1o.

Yahara Variant

The Yahara Variant consists of poorly drained, nearly level soils on glacial lake plains. The native vegetation is American elm, white ash, redosier dogwood, and marsh grasses.

In a representative profile the surface layer is very dark gray silt loam about 9 inches thick. The subsoil is mottled, light brownish gray, friable silt loam about 14 inches thick. The substratum is mottled light gray and light brownish gray, friable, stratified silt, very fine sand, and silty clay loam to a depth of about 60 inches.

The available water capacity is high, and permeability is moderate. These soils are seasonally saturated at a depth of less than 1 foot, unless they are drained. If these soils are not drained, the depth of the root zone is limited by the water table. Natural fertility is medium, and the organic-matter content of the surface layer is moderate.

If drained, most areas of these soils are used for pasture or general farm crops commonly grown in the county. Undrained areas provide good wetland wildlife habitat. A few areas are used for unimproved pasture.

Representative profile of Yahara Variant silt loam in an uncultivated area, 70 feet south and 70 feet east of the northwest corner of sec. 22, T. 27 N., R. 26 E.:

A1—0 to 9 inches; very dark gray (10YR 3/1) silt loam; moderate fine subangular blocky structure; very friable; mildly alkaline; clear wavy boundary.

B2g—9 to 23 inches; light brownish gray (10YR 6/2) silt loam; many medium prominent yellowish brown (10YR 5/6) mottles; weak thick platy structure parting to weak fine subangular blocky; friable; mildly alkaline; clear wavy boundary.

C1—23 to 42 inches; light gray (10YR 7/2) stratified silt and very fine sand; many medium prominent brownish yellow (10YR 6/6) mottles; friable; strongly effervescent; mildly alkaline; clear wavy boundary.

C2—42 to 60 inches; light brownish gray (10YR 6/2) stratified silt and silty clay loam; many medium faint grayish brown (10YR 5/2) mottles; friable; slightly sticky; strongly effervescent; mildly alkaline.

The solum is 15 to 30 inches thick. The solum is commonly mildly alkaline, but in some pedons reaction ranges to neutral. The C horizon is mildly alkaline to moderately alkaline. The A1 or Ap horizon is 6 to 10 inches thick. The B horizon ranges from fine sandy loam to silt loam. The C horizon is typically stratified silt and very fine sand but in places has thin layers of silty clay loam.

Yahara Variant soils are near Yahara soils. They are wetter and have a higher silt and clay content than Yahara soils.

Yv—Yahara Variant silt loam. This nearly level soil is on glacial lake plains. Slopes are 0 to 2 percent. Most areas are irregular in shape and are 5 to 100 acres in size.

Included with this soil in mapping are small areas of Yahara soils. Also included are small areas of soils that have a fine sandy loam surface layer.

Runoff is very slow. The hazard of erosion is slight. Wetness is the main limitation of this soil. This soil receives runoff from adjoining areas and is likely to be ponded during wet seasons and after heavy rains. Surface drainage removes excess water rapidly. Deep ditches provide internal drainage. Where field tiles are used, silt and fine sand will enter the tile lines unless precautions are taken to prevent their entry.

If drained, this soil is suited to corn, small grain, legumes such as red clover, and pasture. Undrained areas are used for unimproved pasture, but are better suited to wetland wildlife habitat than to most other uses. Capability unit IIIw–3; woodland suitability subclass 1o.

Planning the use and management of the soils

The soil survey is a detailed analysis and evaluation of the most basic resource of the survey area—the soil. It may be used to fit the use of the land, including urbanization, to the limitations and potentials of the natural resources and the environment and to help avoid soil-related failures in uses of the land.

During a soil survey soil scientists, conservationists, engineers, and others keep extensive notes, not only about the nature of the soils but also about unique aspects of behavior of these soils in the field and at construction sites. These notes include observations of erosion, drought damage to specific crops, yield estimates, flooding, the functioning of septic systems, and other factors relating the kinds of soil and their productivity, potentials, and limitations under various uses and management. In this way field experience incorporated with measured data on soil properties and performance is used as a basis for predicting soil behavior.

Information in this section will be useful in applying basic facts about the soils to plans and decisions for use and management of soils for crops and pasture, woodland, and many nonfarm uses including building sites, highways and other transportation systems, sanitary facilities, parks and other recreational developments, and wildlife habitat. From the data presented, the potential of each soil for specified land uses may be determined, soil limitations to these land uses may be identified, and costly failures in homes and other structures, because of unfavorable soil properties, may be avoided. A site can be selected where the soil properties are favorable, or practices can be planned that will overcome the soil limitations.

Planners and others using the soil survey can evaluate the impact of specified land uses on the overall productivity of the survey area or other broad planning area and on the environment. Both of these factors are closely related to the nature of the soil. Plans can be made to maintain or create a land use pattern in harmony with the natural soil.

Contractors can find information useful in locating sources of sand and gravel, roadfill, and topsoil. Other information indicates the presence of bedrock, wetness, or very firm soil horizons that cause difficulty in excavation.

Health officials, highway officials, engineers, and many other specialists can find useful information in this soil survey. The safe disposal of wastes, for example, is closely related to properties of the soil. Pavements, sidewalks, campsites, playgrounds, lawns, trees and shrubs, and most other uses of land are influenced by the nature of the soil.

Crops and pasture [2]

The major management concerns when using the soils for crops and pasture are described in this section. In addition, the crops or pasture plants that are best adapted to the soil, including some not commonly grown in the survey area, are discussed; the system of land capability classification used by the Soil Conservation Service is explained; and the predicted yields of the main crops, hay, and pasture are presented for each soil.

This section provides information about the overall agricultural potential and needed practices in the survey area for equipment dealers, drainage contractors, fertilizer companies, processing companies, planners, conservationists, and others. For each kind of soil, information about management is presented in the section "Descriptions of the soils." Planners of management systems for individual fields or farms should also consider the detailed information given in the description of each soil.

More than 170,000 acres in the county was used for crops and pasture in 1973. Of this total, about 15,000 acres was used for permanent pasture; 12,000 acres for row crops, mainly corn; 35,000 acres for close-grown crops, mainly oats; 54,000 acres for rotation hay and pasture; and 13,000 acres for special crops. The rest was idle cropland (*10*).

The potential of the soils in the county for increased production of food is good. About 60,000 acres of potentially good cropland is currently used as woodland, and an estimated 2,000 acres is used as pasture. In addition to the reserve productive capacity represented by this land, food production could also be increased considerably by extending the latest crop production technology to all cropland in the survey area. This soil survey can greatly facilitate the application of such technology.

Acreage in crops and pasture has gradually been decreasing as more land is used for urban development. In 1964 there was an estimated 219,000 acres in farms in the survey area. This figure has been decreasing at the rate of about 2,400 acres per year.

[2] RAYMOND E. HOAGUE, district conservationist, Soil Conservation Service, assisted in preparing this section.

Basic practices of management

Soils that have a hazard of erosion make up about 65 percent of Door County. Erosion is a hazard where slope is more than 2 percent. Emmet, Kewaunee, Longrie, Omena, and Summerville soils are in this group.

Loss of the surface layer by erosion is damaging for two reasons. First, it reduces productivity as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Also, loss of the surface layer is especially damaging on soils that have a clayey subsoil, such as Kewaunee and Kolberg soils, and on soils that have a layer below the subsoil that limits the depth of the root zone. Such layers include sand and gravel, as in Alpena, Kiva, and Casco soils, or bedrock, as in Duel, Kolberg, Longrie, Namur, and Summerville soils. Erosion also reduces productivity on soils that tend to be droughty, such as Boyer and Rousseau soils. Second, erosion on farmland results in sediment entering streams. Controlling erosion reduces pollution of streams by sediment and improves quality of water for municipal use, for recreation, and for fish and wildlife.

In many sloping fields, preparing a good seedbed and tilling are difficult on clayey spots because the original friable surface layer has been eroded. These spots are common on severely eroded Kewaunee soils.

Erosion control provides protective surface cover, reduces runoff, and increases infiltration. A cropping system that keeps plant cover on the soil for extended periods can keep erosion losses to a minimum and will not reduce the productive capacity of the soils. On livestock farms, which require pasture and hay, the legume and grass forage crops in the cropping system reduce erosion on sloping land and provide nitrogen and improve tilth for the following crop.

Slopes are so short and irregular on many of the soils that contour tillage or terracing is not practical in much of the county. Cropping systems that provide substantial plant cover are required to control erosion unless minimum tillage is practiced. Minimizing tillage and leaving crop residue on the surface help to increase infiltration and reduce the hazards of runoff and erosion. These practices can be adapted to most soils in the survey area but are more difficult to use successfully on eroded soils such as the severely eroded Kewaunee soils. No-tillage for corn, which is increasing in Wisconsin, is effective in reducing erosion on sloping land and can be adapted to most soils in the survey area. It is more difficult to practice successfully on soils that have a clayey surface layer, such as Kewaunee soils, than on most other soils.

Terraces and diversions reduce the length of slope and reduce runoff and erosion. They are most practical on deep, well drained, regularly sloping soils. Emmet and Omena soils are suitable for diversions. Soils such as Kolberg, Longrie, and Summerville are less suitable for terracing and diversions because they have a clayey subsoil which would be exposed in terrace channels or they have bedrock at a depth of less than 40 inches.

Contouring and contour stripcropping are also used to control erosion in the survey area. They are best adapted to smoothly and uniformly sloping soils, including most areas of the sloping Emmet and Omena soils.

Soil blowing is a hazard on the sandy Manistee and

Rousseau soils and on the muck soils, Carbondale, Cathro, Markey, and Suamico soils, where they are drained. Blowing can damage these soils in a few hours if winds are strong and the soils are dry and bare of vegetation or surface mulch. Soil blowing can be minimized by maintaining plant cover, surface mulch, or a rough surface through proper tillage. Windbreaks of adapted trees and shrubs are also effective on cultivated muck soils.

Information for the design of erosion control practices for each kind of soil is available in local offices of the Soil Conservation Service or the Cooperative Extension Service.

Soil drainage is the major management need on about 25 percent of the land in the survey area. Some soils are naturally so wet that the production of crops commonly grown in the area is generally not possible. These are the poorly drained Angelica, Bonduel Wet Variant, Deford, Pinconning, and Poygan soils, which make up about 19,000 acres in the survey area; and the organic Carbondale, Cathro, Chippeny, Markey, Rondeau, and Suamico soils, which make up about 29,700 acres.

Unless artificially drained, the somewhat poorly drained soils are so wet that crops are damaged during most years. Allendale, Bonduel, Fabius, Manawa, Solona, Wainola, and Yahara soils, which make up about 38,900 acres, are in this category.

Kewaunee, Kolberg, Kolberg Variant, and Omro soils have good natural drainage most of the year, but they tend to dry out slowly after rains. Crops are sometimes damaged by ponded water where these soils are nearly level.

The design of both surface and subsurface drainage systems varies with the kind of soil. A combination of surface drainage and tile drainage is needed in most areas of the poorly drained and very poorly drained soils that are used for intensive row cropping. Drains have to be more closely spaced in soils with slow permeability than in the more permeable soils. Tile drainage is very slow in Manawa and Poygan soils. Finding adequate outlets for tile drainage systems is difficult in many areas of Bonduel, Bonduel Shallow Variant, Bonduel Wet Variant, Chippeny, Duel Variant, and Namur Variant soils.

Information on design of drainage of each kind of soil is available in local offices of the Soil Conservation Service.

When organic soils are drained, there is a hazard of subsidence, the loss of surface elevation from organic soils after drainage. Subsidence is approximately ½ to 1 inch per year in Wisconsin. The subsidence potential is high for Cathro, Chippeny, Markey, Rondeau, and Suamico soils and very high for Carbondale soils. Subsidence is the result of four factors (1) loss of groundwater buoyancy, (2) consolidation, (3) compaction, and (4) biochemical activity. Elevation loss due to the first three factors is termed initial subsidence and normally takes places in about three years after the water table is lowered. Initial subsidence of organic soils will typically reduce the thickness of the organic materials above the water table by about one-half. After initial subsidence, shrinkage will continue at a fairly uniform rate due to biochemical oxidation of the organic materials. This is continued subsidence and progresses until mineral material or the water table is reached. The deeper the water table, the faster the rate of continued subsidence. Subsidence of organic soils can be stopped by maintaining the water level at the surface. It can be reduced by maintaining the water level as high as possible for the land use. Only a small percentage of the area of organic soils in the county is presently used for crops.

Soil fertility is naturally low or medium in most upland soils in Door County. Most soils range from slightly acid to mildly alkaline. The organic soils, such as Carbondale, Cathro, Markey, Rondeau, and Suamico soils, are neutral to mildly alkaline. These soils require special fertilizers because they are low in boron and other trace elements.

On all soils, additions of lime and fertilizer should be based on the results of soil tests, on the needs of the crop, and on the expected level of yields. The Cooperative Extension Service can help determine the kinds and amounts of fertilizer and lime to apply.

Soil tilth is an important factor in the germination of seeds and in the infiltration of water into the soil. Soils with good tilth are granular and porous.

Most of the soils used for crops in the county have a surface layer of silt loam or loam that is light in color and low in organic-matter content. Generally the structure of such soils is weak, and intense rainfall causes the formation of a crust on the surface. This crust is hard and nearly impervious to water when dry. Once the crust forms, it reduces infiltration and increases runoff. Regular additions of crop residue, manure, and other organic material help to improve tilth and to reduce crust formation.

Fall plowing is generally not a good practice on the light-colored, loamy soils that have a surface layer of silt loam or loam because a crust forms during winter and spring. Also, about 60 percent of the cropland consists of sloping soils that are subject to damaging erosion if they are plowed in fall. Kewaunee, Kolberg, Kolberg Variant, Manawa, Omro, and Poygan soils are clayey, and tilth is a problem because the soils often stay wet until late in spring. If they are wet when plowed, they tend to be very cloddy when dry, and a good seedbed is difficult to prepare. Fall plowing of these soils generally results in better tilth in spring.

Field crops that are suited to the soils and climate of the county include many that are not now commonly grown. Green beans, field peas, winter wheat, barley, potatoes, and similar crops can be grown.

Special crops, such as strawberries, raspberries, sweet corn, and other vegetables, are grown on a small acreage in Door County.

Apples and cherries are the most important orchard crops. Casco, Bonduel, Emmet, Fabius, Longrie, Omena, Omro, Solona, and Yahara soils on slopes of less than 12 percent and are well suited or moderately well suited to apples. Other soils in the survey area are poorly suited or very poorly suited to apple production. Cherries are not so well adapted to wet soils as apples are. The well drained soils, such as Casco, Emmet, Longrie, Omena, Omro, and Sisson soils with slopes of less than 12 percent, are well suited or moderately well suited to cherries. All other soils are poorly suited or very poorly suited to cherry production.

Even if adequately drained, muck soils in the survey

area have a frost hazard and are poorly suited to most vegetable crops. Carbondale, Cathro, Markey, Rondeau, and Suamico soils make up about 29,700 acres of the survey area.

Latest information and suggestions for growing special crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

Capability grouping

Some readers, particularly those who farm on a large scale, may find it practical to use and manage alike some of the different kinds of soil on their farm. These readers can make good use of the capability classification system, a grouping that shows, in a general way, the suitability of soils for most kinds of farming (*8*).

The grouping is based on permanent limitations of soils when used for field crops, the risk of damage when they are farmed, and the way the soils respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to cranberries, horticultural crops, or other crops that require special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitation for forest trees or for engineering.

In the capability system, all kinds of soil are grouped at three levels: the class, the subclass, and the unit. The broadest grouping, the capability class, is designated by Roman numerals I to VIII. In class I are the soils that have the fewest limitations, the widest range of use, and the least risk of damage when they are used. The soils in the other classes have progressively greater natural limitations. In class VIII are soils and land forms so rough, shallow, or otherwise limited that they do not produce worthwhile yields of crops, forage, or wood products.

The subclass indicates major kinds of limitations within the classes. Within most of the classes there can be up to 4 subclasses. The subclasses are indicated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* means that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c* indicates that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few or no limitations. Class V can contain, at the most, only subclasses *w*, *s*, and *c*, because the soils are subject to little or no erosion but have other limitations that confine their use largely to pasture or wildlife.

Subclasses are further divided into groups called capability units. These are groups of soils that are so similar that they are suited to the same crops and pasture plants, they require about the same management, and have generally similar productivity and other response to management. Capability units are generally identified by numbers assigned locally, for example, IIe–1 or IIIs–4.

The capability units in Door County are described on the following pages. The capability unit designation for each soil is given in the "Guide to Mapping Units."

Management by capability units

On the following pages, the capability units in Door County are described and suggestions for use and management of the soils in each unit are given. The capability units are not numbered consecutively, because not all of the units used in Wisconsin are in this county.

Capability unit I–4

Sisson fine sandy loam, 0 to 2 percent slopes, is the only soil in this unit. It is deep and well drained, is on lacustrine plains, and is underlain by stratified silt, very fine sand, and fine sand.

This soil has moderate permeability. Natural fertility is medium and is easy to maintain. Available water capacity is high. Organic-matter content is moderate. This soil is slightly acid to mildly alkaline. The hazard of erosion is slight.

The major management concerns are maintaining organic-matter content, fertility, and tilth. Intensive management consists of applying manure and fertilizer, returning crop residue, and minimum tillage. If this soil is intensively managed, a continuous row cropping system is suitable.

This soil is well suited to all crops commonly grown in the county. Corn, oats, alfalfa, and orchard crops are the main crops. This soil is also well suited to pasture and hardwood timber.

Capability unit IIe–1

Sisson fine sandy loam, 2 to 8 percent slopes, is the only soil in this unit. It is deep and well drained, is on lacustrine plains, and is underlain by stratified silt, fine sand, and very fine sand.

This soil has moderate permeability. Natural fertility is medium. Available water capacity is high. Organic-matter content is moderate. The hazard of erosion is moderate, but this soil is fairly easy to maintain. This soil is slightly acid to mildly alkaline.

The major management concerns are maintaining organic-matter content and tilth and controlling erosion. Applying manure and fertilizer, returning crop residue, and minimum tillage help to maintain tilth, organic-matter content, and fertility. Management practices such as waterways and stripcropping help to control runoff and erosion.

This soil is well suited to all crops commonly grown in the county. Corn, oats, alfalfa, and orchard crops are the main crops. This soil is also well suited to pasture and hardwood timber.

Capability unit IIe–2

This unit consists of gently sloping, moderately deep and deep, well drained and moderately well drained soils on glacial till plains. These soils have a surface layer of sandy loam, loam, and silt loam; and some

have a subsoil of silty clay that is underlain by dolomite bedrock.

Available water capacity is moderate, natural fertility is medium to high, and organic-matter content is moderate in most of these soils. Those soils that have a sandy loam surface layer have lower available water capacity and low natural fertility and organic-matter content. Most of the soils in this unit have moderate permeability, but permeability is moderately slow in a small area. These soils are medium acid to mildly alkaline. The hazard of erosion is moderate. The silt loam soils have a moderate frost hazard.

The main management concerns are maintaining organic-matter content, fertility, and tilth and controlling erosion. Applying manure and fertilizer, returning crop residue, and minimum tillage help to maintain organic-matter content, fertility, and tilth. These management practices are very important on soils that have a subsoil of silty clay. Contour stripcropping helps to control runoff and erosion.

These soils are well suited to all crops commonly grown in the county. Corn, oats, alfalfa, and orchard crops are the main crops. These soils are also well suited to pasture and hardwood timber.

Capability unit IIe–6

This unit consists of gently sloping, deep, well drained to moderately well drained soils on glacial till plains. These soils have a surface layer of silt loam, a subsoil of silty clay, and a substratum of silty clay or loam.

Permeability is moderately slow. The substratum in some of these soils has moderate permeability. Organic-matter content is moderate. Natural fertility is high. Available water capacity is moderate or high. These soils are slightly acid to moderately alkaline. The hazards of erosion and frost action are moderate.

Returning crop residue and applying manure and fertilizer help to maintain organic-matter content, fertility, and tilth. Management practices such as waterways and contour stripcropping help to control runoff and erosion. Although it is not extensively used, a combination of land leveling and field tile or waterways are effective in controlling runoff.

These soils are well suited to corn, oats, and alfalfa hay, which are commonly grown. They are also well suited to pasture and hardwood timber.

Capability unit IIs–1

This unit consists of nearly level, moderately deep and deep, well drained and moderately well drained soils on glacial till plains. These soils have a surface layer of loam and sandy loam and a subsoil of loamy sand, sandy loam, and loam that is underlain by dolomite bedrock or by a substratum of sandy loam.

Available water capacity is low or moderate. Natural fertility is low or medium. These soils have moderate to moderately rapid permeability. Organic-matter content is low or moderate. There is a slight hazard of drought, but otherwise these soils are easy to maintain. These soils are medium acid to mildly alkaline.

The major management concerns are maintaining organic-matter content, fertility, tilth, and moisture. Applying manure and fertilizer, returning crop residue, and minimum tillage are some intensive management practices.

These soils are well suited to all crops commonly grown in the county. Corn, oats, hay, and orchard fruits are the main crops. These soils are also suited to pasture and hardwood.

Capability unit IIs–2

Kolberg silt loam, 0 to 2 percent slopes, is the only soil in this unit. It is moderately deep and well drained, is on glacial till plains, and is underlain by bedrock. This soil has a subsoil of silty clay, clay loam, and silty clay loam.

Available water capacity and organic-matter content are moderate. Permeability is moderate and moderately slow. Natural fertility is high. The hazard of erosion is slight. This soil is neutral to mildly alkaline.

The major management concerns are maintaining organic-matter content, fertility, soil structure, and tilth. Intensive management consists of applying manure and fertilizer, returning crop residue, and minimum tillage. Surface drainage removes excess water rapidly from ponded areas. If this soil is properly managed, a continuous row crop system is suitable.

This soil is well suited to all crops commonly grown in the county. Corn, oats, and alfalfa are the main crops. This soil is also well suited to pasture and hardwood timber.

Capability unit IIs–8

Kewaunee silt loam, 0 to 2 percent slopes, is the only soil in this suit. It is deep and moderately well drained and is on glacial till plains. This soil has a subsoil and substratum of silty clay and heavy clay loam.

Permeability is moderately slow. Organic-matter content and available water capacity are moderate. Natural fertility is high. This soil is slightly acid to mildly alkaline. The hazard of erosion is slight.

Returning crop residue, and applying manure and fertilizer help to maintain organic-matter content, fertility, and tilth. With this type of management, a continuous row crop system is suitable. Surface or subsurface drainage removes excess water rapidly from ponded areas.

This soil is well suited to all crops commonly grown in the county. Corn, oats, and alfalfa are the main crops. This soil is also well suited to pasture and hardwood timber.

Capability unit IIw–1

This unit consists of nearly level, deep, poorly drained soils in drainageways and depressions on glacial till plains. These soils have a surface layer of loam and silty clay loam, and a subsoil and substratum of loam, silty clay loam, or silty clay.

In the silty clay loam soil, permeability is slow, available water capacity is moderate, and organic-matter content and natural fertility are high. In the silt loam soil, permeability is moderately slow to moderate, available water capacity is high, organic-matter content is moderate, and natural fertility is medium. The soils in this unit are neutral to moderately alkaline.

These soils are seasonally saturated at a depth of less than 1 foot, unless they are drained. They also are

Figure 9.—**A series of waterways and diversions safely remove excess water. University of Wisconsin Experimental Station.**

subject to frequent ponding or flooding. Tilth is difficult to maintain where the surface layer is silty clay loam. Surface or tile drains or both are used to remove excess water. Diversions also provide some overflow protection from adjoining slopes. Returning crop residue and applying manure and fertilizer help to maintain organic-matter content, fertility, and tilth. This type of intensive management allows continuous row cropping.

These soils are suited to crops if they are protected from flooding and if adequate drainage is provided. The main crops are corn, oats, and hay. Unimproved areas are suited to pasture, woodland, and wildlife habitat.

Capability unit IIw–2

This soil consists of nearly level and gently sloping, deep, somewhat poorly drained soils in depressions and drainageways on glacial till plains. These soils have a surface layer of silt loam and sandy loam. Most have a subsoil and substratum of loam. Some have a subsoil and substratum of silty clay.

In the loam and sandy loam soils, permeability is moderate; and in the silt loam soil, it is slow. Natural fertility is high in the silt loam soil, medium in the loam soil, and low in the sandy loam soil. Available water capacity of all soils is moderate or high. Organic-matter content is low or moderate. These soils are neutral to moderately alkaline. The hazard of erosion is moderate in a few gently sloping areas. These soils have a slight or moderate hazard of flooding, and they have a high water table. They are seasonally saturated at a depth of 1 to 3 feet, unless they are drained.

Applying manure and fertilizer, returning crop residue, and minimum tillage help to maintain organic-matter content, fertility, and tilth. Diversions provide overflow protection, and surface or tile drains remove excess water (fig. 9).

These soils are suited to continuous row crops if they are protected from overflow and if adequate drainage is provided. Corn, oats, and hay are commonly grown. Unimproved areas are generally suited to pasture, woodland, or wildlife habitat.

Capability unit IIw–3

This unit consists of nearly level, shallow and moderately deep, somewhat poorly drained to poorly drained soils in depressions and drainageways on glacial till plains. The surface layer is loam. These soils are underlain by dolomite bedrock.

Available water capacity is low. Permeability and organic-matter content are moderate. Natural fertility is medium. These soils are neutral to moderately alkaline. The hazard of flooding is slight or moderate.

Minimum tillage, returning crop residue, and applying manure and fertilizer help to maintain the organic-matter content, fertility, and tilth. Diversions protect the soils from flooding, and surface drainage removes excess water from a high water table. In places, bedrock prevents the installation of tile drains. These soils are seasonally saturated at a depth of less than 3 feet, unless they are drained.

These soils are moderately well suited to most crops commonly grown in the county if they are protected from flooding and the high water table is lowered. If they are not protected, the soils are generally suited to pasture, woodland, and wildlife. Corn, oats, and hay are the main crops.

Capability unit IIw–4

Yahara fine sandy loam, 0 to 3 percent slopes, is the only soil in this unit. It is deep and somewhat poorly drained and is on lacustrine plains. The substratum is mainly stratified silt and very fine sand.

Available water capacity is high. Permeability and organic-matter content are moderate. Natural fertility is medium. This soil is neutral to mildly alkaline. The hazard of flooding is slight or moderate.

Minimum tillage, returning crop residue, and applying manure and fertilizer help to maintain the organic-matter content, fertility, and tilth. Diversions protect the soil from flooding, and surface drainage removes excess water from a high water table. Results of tile drainage are questionable. If tile is installed, precautions must be taken to prevent silt and fine sand from entering and clogging the tile lines. This soil is seasonally saturated at a depth of 1 to 3 feet, unless it is drained.

This soil is suited to most crops commonly grown in the county if it is protected from flooding and the high water table is lowered. If not protected, the soil is generally suited to pasture, woodland, or wildlife habitat. Corn, oats, and hay are the main crops.

Capability unit IIIe–2

This unit consists of sloping, moderately deep and deep, well drained soils on glacial till plains. These soils have a surface layer of silt loam, loam, and sandy loam, and most have a subsoil of sandy loam and loam that is underlain by a substratum of sandy loam or by dolomite bedrock. Some areas have a subsoil of silty clay that is underlain by bedrock.

These soils have moderately rapid, moderate, or moderately slow permeability. Available water capacity is moderate to low. Natural fertility is mainly moderate or low, but it is high in soils that have a silt loam surface layer. Organic-matter content is low or moderate. These soils are medium acid to mildly alkaline. The hazard of erosion is moderate. These soils are subject to moderate frost action.

Minimum tillage, returning crop residue, and applying manure and fertilizer help to maintain organic-matter content, fertility, moisture, and tilth. Management practices such as contour stripcropping and waterways help to control runoff and erosion. Under such management, a shorter period of rotation can be used.

The silt loams and loams in this unit are moderately well suited to crops commonly grown in the county, but the sandy loams are poorly suited. The main crops are corn, oats, hay, and orchard fruits. These soils are suited to pasture and hardwood.

Capability unit IIIe–3

This unit consists of gently sloping; shallow, moderately deep, or deep; well drained soils on outwash plains or glacial till plains that are underlain by dolomite bedrock. These soils have a surface layer of loam and sandy loam and a subsoil of gravelly loam, loam, sandy clay loam, or clay loam that is underlain by dolomite bedrock or by sand and gravel.

Permeability is mainly moderate to moderately slow, but some of the soils in this unit have a very rapidly permeable substratum. Organic-matter content is moderate. The available water capacity is low or very low. Natural fertility is medium or low. These soils are slightly acid to mildly alkaline. The hazards of erosion and drought are moderate.

Returning crop residue and applying manure and fertilizer help to maintain organic-matter content, fertility, and moisture. Management practices such as stripcropping and waterways help to control runoff and erosion.

These soils are moderately well suited to the more drought resistant crops in the county, such as oats and some hay crops. Some corn and orchard fruits are grown. These soils are suited to pasture.

Capability unit IIIe–6

Kewaunee silt loam, 6 to 12 percent slopes, eroded, is the only soil in this unit. It is deep and well drained and is on glacial till plains. The subsoil and substratum are silty clay and heavy clay loam.

Permeability is moderately slow. Available water capacity and organic-matter content are moderate. Natural fertility is high. This soil is slightly acid to mildly alkaline. The hazard of erosion is moderate. In some areas, the silty clay subsoil has been exposed by erosion. Frost action is a moderate hazard.

Returning crop residue and applying manure and fertilizer help to maintain organic-matter content, fertility, and tilth. Waterways and stripcropping help to prevent runoff and erosion.

This soil is moderately well suited to all crops commonly grown in the county. Corn, oats, and hay are the main crops. This soil is also suited to pasture and hardwood timber.

Capability unit IIIe–7

This unit consists of sloping, deep, well drained and moderately well drained soils on outwash plains. These soils have a surface layer of loamy sand and fine sand, a subsoil of sandy loam to fine sand, and a substratum of sand and gravel or fine sand.

Permeability is moderately rapid or rapid. Available water capacity, natural fertility, and organic-matter content are low. These soils are medium acid to mildly alkaline. The hazard of erosion is moderate, and these soils are moderately droughty.

Returning crop residue and applying manure and fertilizer help to maintain organic-matter content, fertility, and moisture. Waterways and stripcropping help to control runoff and erosion and to preserve moisture.

These soils are moderately well suited to the crops commonly grown in the county. Corn, hay, and orchard fruits are grown and drought resistant crops such as oats do well. These soils are also suited to pasture and native pine.

Capability unit IIIs–3

This unit consists of gently sloping deep, well drained and moderately well drained soils on outwash plains. The surface layer is loamy sand and fine sand. In some areas the soils have a silty clay substratum.

Available water capacity is low. Permeability is generally rapid. The silty clay substratum that occurs

in some areas has slow permeability. Organic-matter content and natural fertility are low. These soils are medium acid to mildly alkaline. The hazard of erosion is moderate. Droughtiness is the main limitation.

Applying manure and fertilizer and returning crop residue help to maintain organic-matter content and fertility and to conserve moisture. Shelter belts protect the soils from soil blowing.

These soils are moderately well suited to crops commonly grown in the county if good management is used. They are better suited to more drought resistant crops such as oats, but corn and hay are also grown. These soils are also suited to pasture and hardwood timber.

Capability unit IIIs–4

Boyer loamy sand, 2 to 6 percent slopes, is the only soil in this unit. It is deep and well drained and is on outwash plains. It has a sandy loam or fine sandy loam subsoil that is underlain by sand and gravel.

This soil has moderately rapid to rapid permeability. Available water capacity, natural fertility, and organic-matter content are low. This soil is medium acid to mildly alkaline. The hazard of drought is slight to moderate, and the hazard of erosion is slight.

Returning crop residue and applying manure and fertilizer help to maintain organic-matter content and fertility and to conserve moisture. Waterways and stripcropping help to control runoff and erosion and to conserve moisture.

This soil is moderately well suited to the more drought resistant crops grown in the county, such as oats; but corn, hay, and orchard fruits are also grown. This soil is also suited to pasture and hardwood timber.

Capability unit IIIs–8

Summerville loam, 0 to 2 percent slopes, is the only soil in this unit. It is shallow and well drained and is on glacial till plains underlain by dolomite bedrock.

Permeability and organic-matter content are moderate. Available water capacity is very low. Natural fertility is medium or low. This soil is slightly acid to neutral. The hazard of drought is moderate, and the hazard of erosion is slight.

Returning crop residue and applying manure and fertilizer help to maintain organic-matter content and fertility and to conserve moisture.

This soil is moderately well suited to the more drought resistant crops grown in the county such as oats and hay, but corn and orchard crops are also grown. It is also suited to pasture.

Capability unit IIIw–3

Yahara Variant silt loam is the only soil in this unit. It is deep and poorly drained and is on lacustrine plains. Slopes are 0 to 2 percent. This soil is underlain by stratified silt, very fine sand, and silty clay loam.

Permeability and organic-matter content are moderate. Available water capacity is high. Natural fertility is medium. This soil is mildly alkaline.

Applying fertilizer and manure and minimum tillage help to maintain organic-matter content, fertility, and tilth. This soil is seasonally saturated at a depth of less than 1 foot, unless it is drained. Drainage can be provided by surface or tile drains or both. If tile drains are installed, precautions should be taken to prevent silt and very fine sand from filling the tile.

This soil is suited to all crops commonly grown in the county if it is protected from flooding and if adequate drainage is provided.

Capability unit IIIw–5

Fabius silt loam is the only soil in this unit. It is deep and somewhat poorly drained and is on outwash plains. Slopes are 0 to 2 percent. This soil has a sandy clay loam and sandy loam subsoil that is underlain by a sand and gravel substratum.

Available water capacity is low. Organic-matter content is moderate. Natural fertility is medium. Permeability is moderate, but is rapid in the substratum. This soil is neutral to moderately alkaline. The hazard of flooding is slight to moderate.

Minimum tillage, returning crop residue, and applying manure and fertilizer help to maintain organic-matter content, fertility, and tilth. This soil is seasonally saturated at a depth of 1.5 to 2.0 feet, unless it is drained. Diversions protect the soil from flooding, and surface drainage removes excess water from a high water table.

This soil is suited to most crops commonly grown in the county if it is protected from flooding and the high water table is lowered. If this soil is not protected, it is generally suited to pasture, woodland, and wildlife habitat. Corn, oats, and hay are the main crops.

Capability unit IIIw–6

This unit consists of nearly level, deep, somewhat poorly drained soils on lacustrine plains. These soils have a surface layer of loamy sand or loamy fine sand and are underlain by a silty clay substratum.

Permeability is rapid in the subsoil and slow in the substratum. Organic-matter content is low or moderate. Natural fertility is low. Available water capacity is moderate. These soils are slightly acid to moderately alkaline. The hazard of flooding is moderate to severe.

Applying fertilizer and manure and minimum tillage help to maintain organic-matter content, fertility, and tilth. These soils are seasonally saturated at a depth of less than 1.5 feet, unless they are drained. Diversions protect the soils from flooding, and surface or tile drains or both remove excess water. If tile drains are installed, precautions should be taken to prevent fine sand from filling the tiles.

These soils are suited to all crops commonly grown in the county if they are protected from flooding and if adequate drainage is provided. Corn, oats, and hay are the main crops. Unimproved areas are suited to pasture, woodland, or wildlife habitat.

Capability unit IIIw–7

Rondeau muck is the only soil in this unit. It is an organic soil on shallow glacial lake basins or in depressions, and is underlain by marl. Slopes are 0 to 2 percent.

This soil has moderately rapid permeability in the upper part and slow permeability in the marl substratum. Available water capacity and organic-matter content are very high. Natural fertility is low. This soil is neutral to mildly alkaline. The hazard of flooding is severe, and the frost hazard is moderate to severe.

Surface drainage removes excess water. This soil is saturated at a depth of less than 1 foot, unless it is drained. Diversions and channeling protect the soil from flooding. Minimum tillage and applying fertilizer are important management practices.

This soil is suited to corn and truck crops if it is protected from flooding and if adequate drainage is provided. Unimproved areas are suited to pasture or wetland wildlife habitat.

Capability unit IVe–2

This unit consists of deep, moderately steep, well drained soils on hillsides on glacial till plains. These soils have a surface layer of sandy loam; a subsoil of loamy sand, sandy loam, and loam; and a substratum of sandy loam.

Permeability is moderate to moderately rapid. Organic-matter content and natural fertility are low. Available water capacity is moderate. These soils are slightly acid to mildly alkaline. The hazard of erosion is severe. In some areas, the loam subsoil is exposed by erosion.

Minimum tillage, returning crop residue, and applying manure and fertilizer help to maintain organic-matter content, fertility, and tilth. Renovation, waterways, and contour stripcropping help to control runoff and erosion.

These soils are poorly suited to crops commonly grown in the county if good management is not used. Corn, oats, and alfalfa hay are commonly grown. These soils are suited to pasture and hardwood timber.

Capability unit IVe–3

This unit consists of sloping, shallow to deep, well drained soils on glacial till and outwash plains. These soils have a surface layer of sandy loam and loam and a subsoil of gravelly loam, loam, sandy clay loam, or clay loam. These soils are underlain by sand and gravel or dolomite bedrock.

Available water capacity is low or very low. Natural fertility is low or medium. Permeability is generally moderate or moderately slow, but some of the soils have a very rapidly permeable substratum. Reaction is slightly acid to mildly alkaline. The hazards of erosion and drought are moderate. In some areas, the sandy clay loam or silty clay subsoil is exposed by erosion.

Minimum tillage, returning crop residue, and applying fertilizer and manure help to maintain organic-matter content, fertility, tilth, and moisture. Waterways, suitable crop rotation, and stripcropping are other intensive management practices that help to prevent erosion and runoff.

These soils are poorly suited to all crops commonly grown in the county. Best results are obtained from those crops that are most drought resistant. Corn, oats, and alfalfa are common crops. These soils are also suited to pasture and hardwood timber.

Capability unit IVe–7

Boyer loamy sand, 12 to 20 percent slopes, is the only soil in this unit. It is a deep and well drained and is on outwash ridges. This soil has a subsoil of sandy loam.

Permeability is moderately rapid to rapid. Natural fertility, available water capacity, and organic-matter content are low. This soil is medium acid to mildly alkaline.

Minimum tillage and applying fertilizer and manure help to maintain organic-matter content and fertility and to conserve moisture. Waterways, stripcropping, suitable crop rotations, and renovation help to prevent erosion and runoff.

This soil is poorly suited to row crops. If properly managed it is suited to a cropping system that includes some corn as well as drought resistant crops such as oats and hay. It is also suited to pasture and native pine.

Capability unit IVs–3

Duel loamy sand, 1 to 6 percent slopes, is the only soil in this unit. It is a moderately deep, well drained soil on outwash plains underlain by dolomite bedrock. This soil has a subsoil of sand.

Available water capacity is very low. Natural fertility and organic-matter content are low. Permeability is rapid. This soil is slightly acid to mildly alkaline. The soil is dominantly sand, so the hazard of drought is severe and the hazard of soil blowing is moderate.

Applying manure and fertilizer and returning crop residue help to maintain organic-matter content, fertility, and some moisture. Lack of moisture is a limitation, so irrigation shows the greatest favorable results. Shelter belts protect the soil from soil blowing.

This soil is poorly suited to drought resistant crops such as oats. Some areas are also used for corn, legumes, and pasture and are also well suited to pine plantations. This soil is also suitable for irrigation if found in large tracts and if an adequate water supply is available. If this soil is irrigated, it is suited to a continuous row cropping system.

Capability unit IVw–5

This unit consists of nearly level and gently sloping, somewhat poorly drained and poorly drained soils on glacial till and outwash plains. These soils have a surface layer of fine sand, loamy fine sand, or sandy loam and a subsoil of loam, sandy loam, or fine sand. Most of these soils are deep, but some are shallow or moderately deep and are underlain by dolomite bedrock.

Natural fertility is low or medium. Available water capacity is very low or low. Organic-matter content is low to high. Permeability is moderate or rapid. These soils are medium acid to mildly alkaline. The hazard of flooding is severe, and the frost hazard moderate on some of these soils. The hazard of erosion is slight.

Applying manure and fertilizer and returning crop residue help to maintain organic-matter content and fertility. Surface drainage removes excess water, and diversions control runoff from adjacent slopes. These soils are seasonally saturated at a depth of less than 3 feet, unless they are drained.

These soils are poorly suited to crops commonly grown in the county even if adequate drainage and flood protection are provided. The soils are better suited to timber production or wildlife habitat.

Capability unit IVw–7

This unit consists of deep, poorly drained, nearly level, muck soils in depressions on outwash and glacial

lake plains. These soils have a substratum of clay or loam.

Permeability is moderately rapid in the organic layer and slow to moderate in the substratum. Available water capacity and organic-matter content are very high. Natural fertility is low. These soils are neutral to moderately alkaline. The hazard of flooding is severe, and the frost hazard is moderate. Soil blowing and subsidence are concerns if the water table is lowered too far.

Minimum tillage and applying fertilizer help to maintain organic-matter content and fertility. Surface or tile drains remove excess water, and diversions protect the soils from flooding. They are saturated with water at a depth of less than 1 foot, unless they are drained.

These soils are poorly suited to most crops commonly grown in the county even if adequate drainage and flood protection are provided. Early frost limits crops. These soils are better suited to woodland and wildlife habitat.

Capability unit IVw–9

Carbondale muck is the only soil in this unit. It is a deep, very poorly drained, organic soil in glacial lake basins and in depressions in stream valleys. Slopes are 0 to 2 percent.

Permeability is moderately rapid. Available water capacity and organic-matter content are very high. Natural fertility is low. This soil is neutral. The hazard of flooding is severe, and the frost hazard is moderate. Soil blowing and subsidence are concerns if the water table is lowered too far.

Minimum tillage and applying fertilizer help to maintain organic-matter content and fertility. This soil is saturated at a depth of less than 1 foot if drainage is not provided. Surface and tile drains remove excess water, and diversions help to protect the soil from flooding.

This soil is poorly suited to crops commonly grown in the county because of the frost hazard even if adequate drainage and flood protection are provided. This soil is better suited to woodland and wildlife habitat.

Capability unit Vw–14

Only Fluvaquents are in this unit. They are deep, poorly drained, stratified alluvial sediments on flood plains along streams and on bottoms of narrow valleys. The sediments range from gravelly sand to clay loam. Slopes are 0 to 2 percent.

Generally, fertility is moderate, available water capacity is high, and permeability is moderate, but these properties vary. These soils are neutral to moderately alkaline. They are subject to very severe and frequent flooding.

The important management practice on these soils is providing a good grass cover to prevent severe flood damage. Protection from grazing is important in areas of timber and wildlife habitat.

These soils are poorly suited to crops commonly grown in the county. They are better suited to wildlife habitat and production of timber from bottom land trees.

Capability unit VIe–2

Emmet sandy loam, 20 to 35 percent slopes, is the only soil in this unit. It is deep and well drained and is on ridges on glacial till plains. This soil has a loamy sand, sandy loam, and loam subsoil that is underlain by a sandy loam substratum.

Permeability is moderate, but in the substratum it is moderately rapid. Available water capacity is moderate. Organic-matter content and natural fertility are low. The soil is slightly acid to mildly alkaline. The hazard of erosion is very severe. There is also a hazard of drought.

Pasture and hayland are difficult to renovate. Controlled grazing, renovation, and fertilization help to maintain plant cover and control erosion.

This soil is generally unsuited to cultivated crops. If properly managed, it is suited to hay and pasture. This soil is used mostly for woodland and wildlife habitat.

Capability unit VIe–3

Summerville loam, 12 to 20 percent slopes, is the only soil in this unit. It is on glacial till plains and is underlain by dolomite bedrock.

Natural fertility is medium or low. Organic-matter content is moderate. Available water capacity is very low. Permeability is moderate. This soil is slightly acid to neutral. The hazard of erosion is severe. There is also a severe drought hazard.

Pasture and hay stands are difficult to renovate. Renovation and fertilization help to maintain plant cover and control erosion.

This soil is poorly suited to cultivated crops. If properly managed, it is suited to hay and pasture. This soil is used mostly for woodland and wildlife habitat.

Capability unit VIe–6

Only Kewaunee soils, 12 to 20 percent slopes, severely eroded, are in this unit. They are deep and well drained and are on hills on glacial till plains. These soils have a varied surface layer and are underlain by silty clay and heavy clay loam.

Natural fertility is high. Available water capacity is moderate. Permeability is moderately slow. Organic-matter content is low. These soils are slightly acid to mildly alkaline. The hazard of erosion is severe. Because of the loss of topsoil, maintaining good tilth is a concern.

Pasture and hay stands are difficult to renovate. Renovation and fertilization help to maintain plant cover and control erosion.

These soils are generally unsuited to cultivated crops. If properly managed, they are suited to woodland and wildlife habitat.

Capability unit VIs–3

Only Rousseau-Shawano fine sands, 2 to 12 percent slopes, are in this unit. These deep, sandy soils are moderately well drained to excessively drained and are on outwash plains and ridges.

Permeability is rapid. Available water capacity is low. Natural fertility and organic-matter content are low or very low. These soils are medium acid to mildly alkaline. The hazard of erosion, mainly soil blowing, is moderate. There is also a severe drought hazard.

Controlled grazing, renovation, fertilization, and windbreaks or solid plantings help to maintain plant cover and control soil blowing.

These soils are generally unsuited to cultivated crops. If properly managed, they are suited to pasture. These soils are used mostly for unimproved pasture, woodland, or wildlife habitat.

Capability unit VIs–5

This unit consists of nearly level to sloping, deep, shallow or very shallow soils on glacial lake beach ridges and bedrock controlled glacial till plains. These soils have a surface layer of loam to gravelly sandy loam and are underlain by stratified sand and gravel or by dolomite bedrock. Most of these soils are well drained to excessively drained, but some range to poorly drained.

These soils have moderate to very rapid permeability. Available water capacity is low to very low. Organic-matter content is moderate or low. Natural fertility is low. The hazard of erosion is slight to moderate. These soils are neutral to mildly alkaline. Droughtiness is a severe limitation, but some soils are seasonally saturated at a depth of less than 1 foot. Bedrock generally limits use of drainage measures.

Controlled grazing, renovation, and fertilization help to maintain plant cover, control erosion, and conserve moisture.

These soils are generally unsuited to cultivated crops. If properly managed, they are suited to pasture. These soils are used mostly for unimproved pasture, woodland, and wildlife habitat.

Capability unit VIw–7

Markey muck is the only soil in this unit. It is a nearly level, deep, very poorly drained, muck soil that is underlain by sand and is on glacial lake basins and in depressions in stream valleys. Slopes are 0 to 2 percent.

Permeability is moderately rapid in the organic layer and rapid in the sand substratum. Available water capacity is high. Organic-matter content is very high. Natural fertility is low. This soil is neutral to mildly alkaline. The hazard of flooding is severe, and the frost hazard is moderate. Soil blowing and subsidence are concerns if the water table is lowered too far.

This soil is saturated at a depth of less than 1 foot, unless it is drained. Surface and tile drains remove excess water, and diversions can help to protect the soil from flooding. Minimum tillage and applying fertilizer help to maintain organic-matter content and fertility.

This soil is poorly suited to crops commonly grown in the county because of the frost hazard even if adequate drainage and flood protection are provided. It is suited to woodland and wildlife habitat.

Capability unit VIIs–3

Only Rousseau-Shawano fine sands, 12 to 35 percent slopes, are in this unit. These deep, sandy, well drained to excessively drained soils are on outwash ridges.

Permeability is rapid. Available water capacity is low. Natural fertility and organic-matter content are low or very low. These soils are medium acid to mildly alkaline. The hazard of soil blowing is moderate. These soils are also severely droughty.

Controlled grazing, proper woodland management, and tree planting in open areas help to provide plant cover and control soil blowing.

These soils are unsuited to cultivated crops. They are mostly used for unimproved pasture, native woodland, recreation, or wildlife habitat.

Capability unit VIIs–9

This unit consists of gently sloping and sloping, excessively drained beach deposits along major lakes. These soils are sandy and cobbly.

Natural fertility and organic-matter content are low. Permeability is rapid or very rapid. Available water capacity is very low. The hazard of soil blowing is severe if these soils are cultivated. There is also a severe drought hazard.

Management consists of renovation for pasture areas. Protection from grazing is important for woodland and wildlife habitat. Tree plantings in open areas help to provide plant cover and control soil blowing.

These soils are unsuited to cultivated crops. They are better suited to pine plantations. Some areas are in pasture. The soils are also well suited to wildlife habitat.

Capability unit VIIs–10

Chippeny muck is the only soil in this unit. It is an organic soil on old glacial lake basins and is underlain by dolomite bedrock. Slopes are 0 to 2 percent.

Permeability is moderately slow to moderate. Available water capacity is high. Organic-matter content is very high. Natural fertility is low. This soil is neutral to mildly alkaline. The hazard of flooding is severe. This soil is subject to a moderate frost hazard.

This soil is saturated at a depth of less than 1 foot. Underlying bedrock generally limits use of surface or tile drains.

This soil is unsuited to cultivated crops. It is better suited to woodland or wildlife habitat.

Capability unit VIIIs–10

This unit consists of nearly level and gently sloping beaches that are subject to wave action and excessively drained, sloping to steep areas of rock outcrop. Exposed bedrock, mainly dolomite, makes up 75 to more than 90 percent of the areas of rock outcrops.

These areas are not rated for permeability, available water capacity, organic-matter content, and natural fertility.

These areas are unsuited to cultivated crops, pasture, or woodland management because of their position in the landscape and rockiness. They are better suited to or are used mostly for wildlife habitat or recreation.

Capability unit VIIIw–15

Only Saprists are in this unit. These are very poorly drained, organic soils in depressions and in areas bordering lakes and streams. These areas are flooded most of the year. They are covered by cattails, bulrushes, and other plants that grow in shallow water. Slopes are 0 to 2 percent.

These soils are too wet to be used for common farm crops and pasture. Drainage is generally not feasible because there are no suitable outlets. These soils are suited to wetland wildlife habitat. In dry seasons these areas need protection from grazing and from fire. Areas that have completely filled with sediment and that are entirely grown over with cattails can be blasted out with dynamite to form potholes for waterfowl and other wildlife.

Yields per acre

The average yields per acre that can be expected of the principal crops grown in Door County under a high level of management are shown in table 2. In any given year, yields may be higher or lower than those indicated in table 2 because of seasonal variations in rainfall and other climatic factors. Absence of a yield estimate indicates that the crop is not suited to or not commonly grown on the soil or that irrigation of a given crop is not commonly practiced on the soil.

The predicted yields are based mainly on the experience and records of farmers, conservationists, and extension agents (*3*). Results of field trials and demonstrations and available yield data from nearby counties were also considered.

The latest soil and crop management practices used by many farmers in the county are assumed in predicting the yields. Hay and pasture yields are predicted for varieties of grasses and legumes suited to the soil. A few farmers may be using more advanced practices and are obtaining average yields higher than those shown in table 2.

The management needed to achieve the indicated yields of the various crops depends on the kind of soil and the crop. Such management provides drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate tillage practices, including time of tillage and seedbed preparation and tilling when soil moisture is favorable; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; harvesting of crops with the smallest possible loss; and timeliness of all fieldwork.

The predicted yields reflect the relative productive capacity of the soils for each of the principal crops. Yields are likely to increase in the future as new production technology is developed. The relative productivity of a given soil compared to other soils, however, is not likely to change.

Crops other than those shown in table 2 are grown in the survey area, but because their acreage is small, predicted yields for these crops are not included. The local offices of the Soil Conservation Service and the Cooperative Extension Service can provide information about the productivity and management concerns of the soils for these crops.

Woodland management and productivity [3]

All of Door County was in forest before it was settled. This forest was a mixture of conifers and hardwoods. Currently 33 percent of the county, or 106,000 acres, is in forest. About 96,000 acres is classified as commercial forest in the forest inventory published in 1968 (fig. 10).

The present forest area is 21 percent conifers; 0.7 percent oak and hickory; 14 percent elm, ash, and maple; 33 percent maple, beech, and birch; 22 percent aspen and white birch; and 3 percent nonstocked (*11*).

Although a third of the county is forested, forestry is not an important industry. The recreational value of the forest stand is more important economically than the commercial production of wood products. The most important wood products are maple logs, aspen pulp, and cedar posts and poles. Kolberg, Namur, and Summerville soils, which are very shallow to moderately deep over bedrock, are difficult to reforest if they have been cleared and farmed. In many areas of these soils, a highly calcareous subsoil and substratum have been brought to the surface by tillage operations. This is toxic to tree growth and it either kills or severely inhibits growth of seedlings.

Table 3 contains information useful to woodland owners or forest managers planning use of soils for wood crops. Mapping unit symbols for those soils suitable for wood crops are listed alphabetically by soil name, and the ordination symbol for each soil is given. All soils bearing the same ordination symbol require the same general kinds of woodland management and have about the same potential productivity.

The first part of the symbol, a number, indicates the potential productivity of the soils for important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *w* indicates excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates no significant limitations or restrictions. If a soil has more than one limitation, priority in placing the soil into a limitation class is in the order in which the letters are listed above— w, t, d, c, s, f, and r.

In table 3 (See page 62) the soils are also rated for a number of factors to be considered in management. The ratings of slight, moderate, and severe are used to indicate the degree of major soil limitations.

Ratings of equipment limitation reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or need for some modification in management or equipment; *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree that the soil affects expected mortality of planted tree seedlings when plant competition is not a limiting factor. The ratings are for seedlings from good planting stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality of the planted seedlings is less than 25 per-

[3] By GEORGE W. ALLEY, forester, Soil Conservation Service, Madison, Wisconsin.

Figure 10.—Tree planting is an established program in the county. This planting is on soils of the Emmet and Omena series.

cent; *moderate,* 25 to 50 percent; and *severe,* more than 50 percent.

Considered in the ratings of windthrow hazard are characteristics of the soil that affect the development of tree roots and the ability of soil to hold trees firmly. A rating of *slight* indicates that trees in wooded areas are not expected to be blown down by commonly occurring winds; *moderate,* that some trees are blown down during periods of excessive soil wetness and strong winds; and *severe,* that many trees are blown down during periods of excessive soil wetness and moderate or strong winds.

Ratings of plant competition indicate the degree to which undesirable plants are expected to invade or grow if openings are made in the tree canopy. The invading plants compete with native plants or planted seedlings by impeding or preventing their growth. A rating of *slight* indicates little or no competition from other plants; *moderate* indicates that plant competition is expected to hinder the development of a fully stocked stand of desirable trees; and *severe* indicates that plant competition is expected to prevent the establishment of a desirable stand unless the site is intensively prepared, weeded, or otherwise managed for the control of undesirable plants.

The potential productivity of merchantable trees on a soil is expressed as a site index. This index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands.

Trees to plant are those that are suitable for commercial wood production and that are suited to the soils.

Windbreaks and environmental plantings

Windbreaks are established to protect livestock, buildings, and yards from wind and snow. They also help to protect fruit trees and gardens, and they furnish wildlife habitat. Several rows of both broad-leaved and coniferous species provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. These field windbreaks protect cropland and crops from wind and hold snow on the fields, and they also provide food and cover for wildlife.

Environmental plantings help to beautify and screen homes and other buildings and to abate surrounding noise. The plants, mostly evergreen shrubs and trees, are closely spaced. Healthy planting stock of suitable species planted properly on a well prepared site and maintained in good condition can insure a high degree of plant survival.

Table 4 (See page 68) shows the height that locally adapted trees and shrubs are expected to reach on

TABLE 2.—*Yields per acre of crops and pasture*

[All yields were estimated for a high level of management in 1974. Absence of a yield figure indicates the crop is seldom grown or is not suited]

Soil name and map symbol	Corn	Corn silage	Oats	Grass-legume hay	Kentucky bluegrass
	Bu	*Ton*	*Bu*	*Ton*	*AUM* [1]
Allendale:					
AdA	75	12	60	3.5	3.3
Alpena:					
ApC	----	8	----	2.0	1.6
Angelica:					
Ax	75	12	65	4.0	3.5
Beaches:					
Be.					
Bonduel:					
Bn	75	12	65	3.5	3.5
Bonduel Shallow Variant:					
Bo	45	7	45	4.0	1.6
Bonduel Wet Variant:					
Bp	70	12	55	3.0	3.0
Boyer:					
BrB	70	12	50	2.1	2.0
BrC, BrD	60	10	45	2.0	1.6
Carbondale:					
Ca	----	12	----	2.4	----
Casco:					
CcB	70	12	50	2.5	3.0
CcC2	60	10	45	2.0	2.5
Cathro:					
Cm	----	12	55	2.5	----
Chippeny:					
Cp.					
Deford:					
De	65	11	45	2.5	2.3
Duel:					
DuB	40	7	35	2.0	2.3
Duel Variant:					
Dv	50	8	40	2.5	2.5
Emmet:					
EmA	85	14	75	4.0	3.5
EmB	80	13	70	3.8	3.5
EmC2	75	12	65	3.5	3.5
EmD2	----	----	50	2.5	2.7
EmE	----	----	----	2.0	2.0
Fabius:					
Fa	75	12	60	2.5	3.5
Fluvaquents:					
Fu	----	----	----	----	3.0
Gravel pits:					
Gp.					
Kewaunee:					
KhA, KhB	85	14	75	4.5	3.5

TABLE 2.—*Yields per acre of crops and pasture*—Continued

Soil name and map symbol	Corn	Corn silage	Oats	Grass-legume hay	Kentucky bluegrass
	Bu	*Ton*	*Bu*	*Ton*	*AUM* [1]
KhC2	80	13	75	4.5	3.2
KkD3	60	10	60	4.0	2.5
Kiva:					
KmB	----------	12	60	2.0	1.6
KmC	----------	8	50	1.9	1.6
Kolberg:					
KoA	90	15	70	3.7	3.0
KoB	80	13	65	3.7	3.0
KoC2	65	11	55	3.0	2.6
Kolberg Variant:					
KvB	70	12	65	3.2	2.3
KvC2	60	10	60	3.2	2.0
Longrie:					
LoA	80	13	65	3.5	3.5
LoB	75	12	60	3.0	3.0
LoC	70	12	55	2.5	2.5
Manawa:					
McA	90	15	75	4.5	3.5
Manistee:					
MeB	65	11	60	3.0	2.0
Markey:					
Mk	----------	12	55	2.5	----------
Namur:					
NaB, NaC	----------	----------	30	2.0	1.3
Namur Variant:					
Nv	30	5	35	1.7	1.3
Omena:					
OmB	75	12	75	3.5	3.0
OmC	70	12	70	3.3	2.5
OmD	----------	----------	60	3.1	2.5
Omena Variant:					
OvB	90	15	65	4.0	3.5
Omro:					
OzB	85	14	70	4.5	3.5
Pinconning:					
Pn	80	13	60	3.5	2.5
Poygan:					
Po	100	17	65	4.0	3.5
Rock outcrop:					
Ra.					
Namur:					
[2] Rb	----------	----------	30	2.0	3.0
Rondeau:					
Rn	----------	12	50	----------	----------

TABLE 2.—*Yields per acre of crops and pasture*—Continued

Soil name and map symbol	Corn	Corn silage	Oats	Grass-legume hay	Kentucky bluegrass
	Bu	*Ton*	*Bu*	*Ton*	*AUM* [1]
Rousseau:					
RoB	45	8	40	2.0	2.5
RoC	40	7	35	2.0	2.0
[2] RpC	45	8	35	2.4	2.0
[2] RpD	----	----	----	1.8	1.5
[2] RrB	50	8	45	2.0	2.5
Saprists:					
Sa.					
Sisson:					
SnA	100	17	75	4.5	3.5
SnB	95	16	70	4.5	3.5
Solona:					
SoA	90	15	65	4.0	3.5
Suamico:					
Su	----	12	55	2.5	----
Summerville:					
SvA	75	12	70	3.5	3.0
SvB	70	12	65	3.5	3.0
SvC	60	10	60	3.0	2.5
SvD	----	----	----	2.5	2.0
Udipsamments:					
Ud.					
Udorthents:					
Uo.					
Wainola:					
Wa	55	9	45	2.0	2.0
Yahara:					
YaA	75	12	50	3.0	3.0
Yahara Variant:					
Yv	85	14	60	3.5	4.0

[1] Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for a period of 30 days.

[2] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

various kinds of soils in 20 years. The estimates in this table, based on measurements and observation of established plantings that have been given adequate care, can be used as a guide in planning windbreaks and screens. Additional information about planning windbreaks and screens and the planting and care of trees can be obtained from the local office of the Soil Conservation Service, Cooperative Extension Service, local nurserymen, or the Wisconsin Department of Natural Resources forester.

Recreation [4]

The demand for land and facilities for recreational activities is increasing everywhere in the survey area. Such activities include golfing, camping, snowmobiling, picnicking, bicycling, hiking, boating, and tennis (fig. 11). Hundreds of acres have been removed from

[4] RAYMOND E. HOAGUE, district conservationist, Soil Conservation Service, assisted in preparing this section.

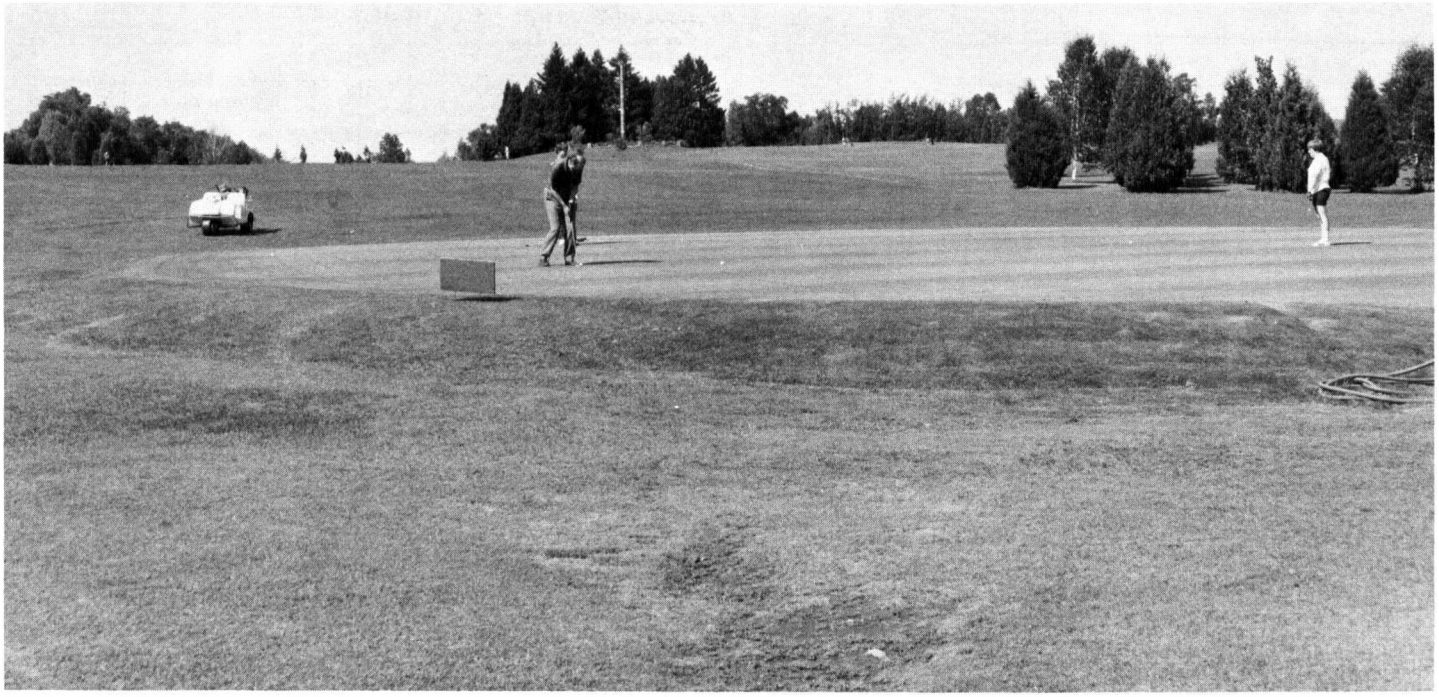

Figure 11.—**Golf course on gently sloping soils of the Longrie series. These soils are well suited to most farm crops but have severe limitations for some nonfarm uses, such as septic tank absorption fields.**

agricultural production and are used for second-home areas for numerous nonresidents.

The soils of the survey area are rated in table 5 (See page 73) according to limitations that affect their suitability for camp areas, picnic areas, playgrounds, and paths and trails. The ratings are based on such restrictive soil features as flooding, wetness, slope, and texture of the surface layer. Not considered in these ratings, but important in evaluating a site, are location and accessibility of the area, size and shape of the area and its scenic quality, the ability of the soil to support vegetation, access to water, potential water impoundment sites available, and either access to public sewerlines or capacity of the soil to absorb septic tank effluent. Soils that are subject to flooding are limited, in varying degree, for recreational use by the duration of flooding and the season when it occurs. Onsite assessment of height, duration, and frequency of flooding is essential in planning recreational facilities.

In table 5, the limitations of soils are rated as slight, moderate, or severe. *Slight* means that the soil properties are generally favorable and that the limitations are minor and easily overcome. *Moderate* means that the limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 5 can be supplemented by additional information in other parts of this survey. Especially helpful are interpretations for septic tank absorption fields, given in table 8; and interpretations for dwellings without basements and for local roads and streets, given in table 7.

Camp areas require such site preparation as shaping and leveling tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils for this use are mildly sloping, are not wet, and are not subject to flooding during the period of use. The surface has few or no stones or boulders; absorbs rainfall readily, but remains firm; and is not dusty when dry. The cost of constructing camping sites greatly increases if the soils are strongly sloping and they have stones or boulders.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for use as picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that will increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level, are not wet, and are not subject to flooding during the season of use. The surface is free of stones or boulders, is firm after rains, and is not dusty when dry. If shaping is required to obtain a uniform grade, the depth of the soil over rock should be sufficient to allow necessary grading.

The design and layout of paths and trails for walking, horseback riding, and bicycling should require little or no cutting and filling. The best soils for this

use are those that are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once during the period of use. They should be moderately sloping and have few or no stones or boulders on the surface.

Wildlife habitat [5]

The soils of Door County range widely in physical and chemical composition. Most of the soils in the northern two-thirds of the county are rough or are shallow over dolomite bedrock. Many areas in this part of the county are not farmed, but they remain in woodland or wetland. The southern one-third of the county is smoother, and most of this area is farmed. Most of the wetlands are in this section. According to an inventory made in 1961, there is approximately 28,000 acres of wetlands. Most of these wetlands are wooded swamps.

The habitat elements needed by a wildlife species generally require several kinds of soil and commonly a combination of land uses. For this reason, interpretations of the soils can be best related to the soil associations described in the section, "General Soil Map." In the following paragraphs, the soil associations of Door County are described as wildlife areas that differ in potential species, mainly game, and in environmental factors.

Wildlife area 1—This area is in the Summerville-Longrie-Omena association, which is in the northern two-thirds of the county. The soils are nearly level to moderately steep and are medium textured. Much of this area is uncultivated. This association provides good interspersions of cropland and woodland for food and cover, but wetlands are very sparse.

Wildlife in this area includes white-tailed deer, cottontail rabbits, gray squirrels, and smaller populations of Hungarian partridge, ringneck pheasants, ruffed grouse, and snowshoe hares.

Wildlife area 2—This area is in the Emmet-Solona-Angelica, Rousseau-Kiva-Markey, and Kewaunee-Kolberg-Manawa associations, which are mainly in the southern one-third of the county. The soils are nearly level to sloping and are medium or coarse textured. Much of this area is cultivated. The Emmet-Solona-Angelica and Kewaunee-Kolberg-Manawa associations are mostly cultivated, but they contain areas of steeper soils and wet soils in drainageways and depressions. These areas are used for woodland or for wetland wildlife habitat. The Rousseau-Kiva-Markey association is used mostly for pasture, woodland, or wetland wildlife habitat. Rousseau soils are sandy and droughty and not extensively used for crops. The very poorly drained Markey soils and the closely interspersed wet soils in the Deford-Yahara Variant-Carbondale and the Carbondale-Cathro associations provide numerous wet areas.

Wildlife in this area includes white-tailed deer, ruffed grouse, waterfowl, cottontail rabbits, gray squirrels, and a limited number of ringneck pheasants and Hungarian partridge.

Wildlife area 3—This area is in the Deford-Yahara Variant-Carbondale and Carbondale-Cathro associations, which are in the southern one-third of the county. The soils are nearly level and are medium textured, coarse textured, and organic that remain wet much of the year. Most of this area is used for pasture, woodland, or wetland wildlife habitat. Most of the wetlands in Door County are in Area 3. This area is closely interspersed with better drained soils of Area 2, and so it provides a variety of soil and land use conditions which favor wildlife.

Wildlife in this area includes mallards, wood ducks, and many species of diving ducks; white-tailed deer; ruffed grouse; cottontail rabbits; gray squirrels; and a limited number of ringneck pheasants and snowshoe hares.

Soils directly affect the kind and amount of vegetation that is available to wildlife as food and cover, and they affect the development of water impoundments. The kind and abundance of wildlife that populate an area depend largely on the amount and distribution of food, cover, and water. If any one of these elements is missing, inadequate, or inaccessible, wildlife will either be scarce or will not inhabit the area.

If the soils have the potential, wildlife habitat can be created or improved by planting appropriate vegetation, by properly managing the existing plant cover, and by fostering the natural establishment of desirable plants.

In table 6, (See page 77) the soils in the survey area are rated according to their potential to support the main kinds of wildlife habitat in the area. This information can be used in planning the use of parks, wildlife refuges, nature study areas, and other developments for wildlife; selecting soils that are suitable for creating, improving, or maintaining specific elements of wildlife habitat; determining the intensity of management needed for each element of the habitat; and determining areas that are suitable for acquisition to manage for wildlife.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* means that the element of wildlife habitat or the kind of habitat is easily created, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected if the soil is used for the designated purpose. A rating of *fair* means that the element of wildlife habitat or kind of habitat can be created, improved, or maintained in most places. Moderate intensity of management and fairly frequent attention are required for satisfactory results. A rating of *poor* means that limitations are severe for the designated element or kind of wildlife habitat. Habitat can be created, improved, or maintained in most places; but management is difficult and requires intensive effort. A rating of *very poor* means that restrictions for the element of wildlife habitat or kind of wildlife are very severe, and that unsatisfactory results can be expected. Wildlife habitat is impractical or even impossible to create, improve, or maintain on soils having such a rating.

The elements of wildlife habitat are briefly described in the following paragraphs.

Grain and seed crops are seed-producing annuals

[5] By DAVID J. FRISQUE, biological technician, wildlife, Soil Conservation Service.

TABLE 3.—*Woodland management and productivity*

[Only the soils suitable for production of commercial trees are listed in this table. Absence of an entry in a column means the information was not available]

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Important trees	Site index	
Allendale: AdA	3w	Moderate	Severe	Slight	Slight	Quaking aspen White ash Swamp white oak Eastern white pine White spruce Paper birch Balsam fir	60	White spruce, eastern white pine.
Alpena: ApC	4s	Slight	Slight	Slight	Moderate	Northern white-cedar Balsam fir Quaking aspen Paper birch	29	Red pine, white spruce.
Angelica: Ax	4w	Severe	Severe	Severe	Slight	Balsam fir Quaking aspen Northern white-cedar Black ash	45	White ash, northern white-cedar.
Bonduel: Bn	3o	Slight	Slight	Slight	Moderate	Northern white-cedar Quaking aspen Paper birch	35	Poplars, white spruce.
Bonduel Shallow Variant: Bo	3w	Moderate	Slight	Moderate	Moderate	Northern white-cedar Quaking aspen Paper birch	35	Poplars, white spruce.
Bonduel Wet Variant: Bp	4w	Severe	Moderate	Moderate	Severe	Northern white-cedar Quaking aspen Paper birch	25	Poplars, white spruce.
Boyer: BrB, BrC, BrD	2s	Slight	Slight	Slight	Moderate	Northern red oak White oak American basswood Sugar maple	66	Eastern white pine, red pine.
Carbondale: Ca	3w	Severe	Severe	Severe	Severe	Balsam fir Northern white-cedar Tamarack	34 45	
Casco: CcB, CcC2	3s	Slight	Slight	Slight	Slight	Northern red oak Black oak White oak	55	Red pine, jack pine.

Cathro:								
Cm	3w	Severe	Severe	Severe	Severe	Balsam fir		
						Tamarack	50	
						Northern white-cedar	33	
						Red maple		
						White ash		
Chippeny:								
Cp	3w	Severe	Severe	Severe	Severe	Balsam fir	50	
						Black ash		
						Paper birch		
						Northern white-cedar		
						Red maple		
						Quaking aspen		
						Tamarack		
Deford:								
De	5w	Severe	Severe	Severe	Severe	Quaking aspen	45	Red maple, white ash.
						Balsam fir		
						Red maple		
						Silver maple		
						White ash		
Duel:								
DuB	3s	Slight	Moderate	Slight	Slight	Northern red oak	53	Red pine, jack pine.
						Paper birch		
Duel Variant:								
Dv	3w	Severe	Moderate	Moderate	Severe	White ash	55	White ash, red maple, white spruce.
						Red maple		
Emmet:								
EmA, EmB, EmC2, EmD2	2o	Slight	Slight	Slight	Moderate	Sugar maple	61	White spruce, red pine, eastern white pine.
						Yellow birch		
						Red pine		
						American basswood		
						American beech		
						Quaking aspen	75	
						Eastern white pine		
						Northern red oak		
EmE	2r	Moderate	Slight	Slight	Moderate	Sugar maple	61	White spruce, red pine.
						Yellow birch		
						Red pine		
						American basswood		
						American beech		
						Quaking aspen	75	
						Eastern white pine		
						Northern red oak		
Fabius:								
Fa	3w	Moderate	Moderate	Moderate	Severe	Northern red oak	65	White spruce, Norway spruce, eastern white pine, northern white-cedar.
						Pin oak		
						White ash		
						American basswood		
Fluvaquents:								
Fu	4w	Severe	Moderate	Moderate	Severe	Red maple	50	Red maple, white ash, poplars.
						White ash		
Kewaunee:								
KhA, KhB, KhC2	2c	Slight	Slight	Slight	Moderate	Northern red oak	66	Eastern white pine, red pine, white spruce.
						Sugar maple		
						White ash		
						American basswood		

TABLE 3.—*Woodland management and productivity*—Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Important trees	Site index	
KkD3	2c	Severe	Severe	Slight	Moderate	Northern red oak	66	Eastern white pine, red pine, white spruce.
						Sugar maple		
						White ash		
						American basswood		
Kiva:								
KmB, KmC	2s	Slight	Slight	Slight	Moderate	Sugar maple	61	Red pine, white spruce, eastern white pine, Austrian pine.
						American basswood		
						Quaking aspen		
						Bigtooth aspen		
Kolberg:								
KoA, KoB, KoC2	2c	Slight	Moderate	Moderate	Moderate	Northern red oak	66	Eastern white pine, red pine, white spruce.
						Sugar maple	67	
						White ash		
						American basswood		
Kolberg Variant:								
KvB, KvC2	3d	Slight	Moderate	Moderate	Slight	Sugar maple	53	Red pine.
						Red pine		
						Eastern white pine		
						Northern red oak		
						Northern white-cedar		
Longrie:								
LoA, LoB, LoC	2o	Slight	Slight	Slight	Moderate	Sugar maple	61	White spruce, eastern white pine, red pine.
						Yellow birch		
						American beech		
						American basswood		
						Northern red oak		
						Red pine		
Manawa:								
McA	2c	Slight	Slight	Slight	Moderate	Sugar maple	58	Red maple, green ash, white ash, white spruce.
						American beech		
						Green ash	52	
						Red maple	52	
Manistee:								
MeB	2s	Slight	Moderate	Slight	Moderate	Sugar maple	61	Red pine.
						Eastern white pine		
						Red maple		
						Red pine		
						American basswood		
						Eastern hemlock		
						Northern red oak		
						White ash		
Markey:								
Mk	3w	Severe	Severe	Severe	Severe	Balsam fir	50	
						Tamarack		
						Quaking aspen		
						Northern white-cedar		
						Red maple		

Namur: NaB, NaC	4d	Slight	Severe	Severe	Slight	Sugar maple White ash Eastern white pine Northern white-cedar	49 50 — —	Red pine, eastern white pine.
Namur Variant: Nv	4w	Severe	Severe	Severe	Severe	Northern white-cedar White ash	25 —	
Omena: OmB, OmC, OmD	2o	Slight	Slight	Slight	Moderate	Sugar maple Yellow birch Eastern white pine White ash American basswood	61 — — — —	White spruce, eastern cottonwood.
Omena Variant: OvB	2w	Moderate	Slight	Slight	Moderate	Sugar maple Yellow birch American beech	60 — —	Eastern white pine, white spruce.
Omro: OzB	2c	Slight	Severe	Severe	Moderate	Sugar maple Northern red oak White ash Red maple	58 — — —	Eastern white pine, red pine, white spruce.
Pinconning: Pn	5w	Severe	Severe	Severe	Severe	Quaking aspen Black ash Black spruce Northern white-cedar	40 — — —	
Poygan: Po	2w	Severe	Severe	Moderate	Severe	White ash Red maple	65 —	White spruce, red maple, white ash.
Namur: [1] Rb	4d	Moderate	Severe	Severe	Slight	Sugar maple White ash Eastern white pine Northern white-cedar	49 50 — —	Red pine, eastern white pine.
Rousseau: RoB, RoC	2s	Slight	Severe	Slight	Moderate	Sugar maple Red maple Balsam fir Northern red oak Eastern white pine Red pine Jack pine Black oak	61 — — 70 65 65 55 66	Red pine, jack pine, white spruce.
[1] RpC: Rosseau part	2s	Slight	Severe	Slight	Moderate	Sugar maple Red maple Balsam fir Northern red oak Eastern white pine Red pine Jack pine Black oak	61 — — 70 65 65 55 66	Red pine, jack pine, white spruce.

TABLE 3.—*Woodland management and productivity*—Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Important trees	Site index	
Shawano part	2s	Slight	Slight	Slight	Moderate	Northern red oak	66	Red pine, eastern white pine.
						Red pine	62	
						Eastern white pine	66	
						Red maple		
						Paper birch		
[1] RpD: Rousseau part	2s	Severe	Severe	Slight	Moderate	Sugar maple	61	Red pine, jack pine, white spruce.
						Red maple		
						Balsam fir		
						Northern red oak	70	
						Eastern white pine	65	
						Red pine	65	
						Jack pine	55	
						Black oak	66	
Shawano part	2s	Moderate	Slight	Slight	Moderate	Northern red oak	66	Red pine, eastern white pine.
						Red pine	62	
						Eastern white pine	66	
						Red maple		
						Paper birch		
[1] RrB: Rousseau part	2s	Slight	Severe	Slight	Moderate	Sugar maple	61	Red pine, jack pine, white spruce.
						Red maple		
						Balsam fir		
						Northern red oak	70	
						Eastern white pine	65	
						Red pine	65	
						Jack pine	55	
						Black oak	66	
Deford part	5w	Severe	Severe	Severe	Severe	Quaking aspen	45	
						Balsam fir		
						Northern white-cedar		
						American basswood		
						Red maple		
						Silver maple		
Sisson: SnA, SnB	1o	Slight	Slight	Slight	Moderate	Northern red oak	70	Eastern white pine, white spruce, Norway spruce, red pine.
						White ash		
						American basswood		
						Sugar maple		
Solona: SoA	2o	Slight	Slight	Slight	Moderate	Sugar maple	63	Eastern white pine, red pine, white spruce.
						Northern red oak	68	
						White ash		
						American basswood		
Suamico: Su	3w	Severe	Severe	Severe	Severe	Northern white-cedar	35	
						Tamarack		
						Red maple		
						White ash		

Summerville:								
SvA, SvB, SvC, SvD	3d	Slight	Moderate	Moderate	Slight	Sugar maple	50	Red pine, eastern white pine.
						Paper birch		
						Quaking aspen		
						Northern white-cedar		
Wainola:								
Wa	3w	Moderate	Severe	Slight	Slight	Quaking aspen	60	White spruce, Norway spruce, eastern white pine.
						White ash		
						Red maple		
						Sugar maple		
						Northern red oak		
Yahara:								
YaA	1o	Slight	Slight	Slight	Moderate	Red maple	70	Eastern white pine, white spruce, silver maple, white ash.
						Sugar maple	60	
						Northern red oak	70	
						American basswood		
						American beech		
Yahara Variant:								
Yv	1w	Severe	Moderate	Moderate	Severe	Silver maple	93	Silver maple, red maple, white ash.
						Red maple	90	
						White ash	80	

[1] This mapping unit is made up of two or more dominant kinds of soils. See mapping unit description for the composition and behavior of the whole mapping unit.

TABLE 4.—*Windbreaks and environmental plantings*

[The symbol < means less than; the symbol > means greater than. Absence of an entry means soil does not normally grow trees of this height class]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of—				
	<8	8–15	16–25	26–35	>35
Allendale: AdA		White spruce, American cranberrybush, silky dogwood.	Black spruce, northern white-cedar, tall purple willow.		
Alpena: ApC		White spruce nannyberry viburnum.	Red pine, eastern white pine, northern white–cedar, Austrian pine, Siberian crabapple, hawthorn.	American mountain-ash.	
Angelica: Ax		White spruce, silky dogwood.	Northern white-cedar, black spruce.		Carolina poplar.
Beaches: Be.					
Bonduel: Bn		Northern white-cedar, red-osier dogwood, nannyberry viburnum.	Green ash, white spruce.	Eastern white pine, jack pine, silver maple.	
Bonduel Variant: Bo, Bp		Northern white-cedar, red-osier dogwood, nannyberry viburnum.	Green ash, white spruce.	Eastern white pine, jack pine, silver maple.	
Boyer: BrB, BrC, BrD		Autumn-olive, Vanhoutte spirea, Tatarian honeysuckle, Amur privet.	Red pine	Eastern white pine, jack pine.	
Carbondale: Ca		Black spruce, silky dogwood.	Austrian pine, nannyberry viburnum.	Northern white-cedar, Scotch pine.	
Casco: CcB, CcC2		Northern white-cedar, lilac, common ninebark, silky dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine.	
Cathro: Cm		Tatarian honeysuckle, silky dogwood, white spruce.	Austrian pine, laurel willow.	Northern white-cedar, eastern white pine.	
Chippeny: Cp		Silky dogwood, Tatarian honeysuckle.		Northern white-cedar.	Red maple.
Deford: De		Nannyberry viburnum, arrowwood.	Northern white-cedar, eastern white pine, black spruce.		

TABLE 4.—*Windbreaks and environmental plantings*—Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of—				
	<8	8–15	16–25	26–35	>35
Duel: DuB		White spruce	Eastern white pine, hawthorn, Siberian crabapple.	Red pine, red maple, jack pine.	
Duel Variant: Dv		Northern white-cedar, red-osier dogwood, nannyberry viburnum.	Green ash, white spruce.	Eastern white pine, jack pine, silver maple.	
Emmet: EmA, EmB, EmC2, EmD2, EmE.		White spruce, arrowwood, lilac, blue spruce, Amur honeysuckle.	Red pine		Red maple.
Fabius: Fa.					
Fluvaquents: Fu		Northern white-cedar, red-osier dogwood, nannyberry viburnum.	Green ash, white spruce.	Eastern white pine, jack pine, silver maple.	
Gravel pits: Gp.					
Kewaunee: KhA, KhB, KhC2, KkD3.		Northern white-cedar, lilac, common ninebark, silky dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine.	
Kiva: KmB, KmC		White spruce, nannyberry viburnum, shadblow serviceberry.	Red pine, eastern white pine, Austrian pine, hawthorn, Siberian crabapple.		
Kolberg: KoA, KoB, KoC2		Northern white-cedar, common ninebark, silky dogwood, lilac.	White spruce, Norway spruce.	Eastern white pine, red pine.	
Kolberg Variant: KvB, KvC2	Manyflower cotoneaster.	Lilac	Norway spruce, Siberian peashrub.	Eastern white pine, red pine, jack pine.	
Longrie: LoA, LoB, LoC		White spruce, arrowwood.	Red pine		Red maple.
Manawa: McA		Northern white-cedar, lilac, common ninebark, silky dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine.	
Manistee: MeB			Red pine, American mountainash, Siberian crabapple, hawthorn.		

TABLE 4.—*Windbreaks and environmental plantings*—Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of—				
	<8	8–15	16–25	26–35	>35
Markey: Mk		Silky dogwood	Austrian pine, laurel willow.	Eastern white pine, Scotch pine, northern white-cedar.	
Namur: NaB, NaC	Manyflower cotoneaster.	Lilac	Norway spruce, Siberian peashrub.	Eastern white pine, red pine, jack pine.	
Namur Variant: Nv		Northern white-cedar, red-osier dogwood, nanny-berry viburnum.	Green ash, white spruce.	Eastern white pine, jack pine, silver maple.	
Omena: OmB, OmC, OmD		White spruce, Amur privet.	Northern white-cedar.	White ash	Carolina poplar.
Omena Variant: OvB		Northern white-cedar, red-osier dogwood, nanny-berry viburnum.	Green ash, white spruce.	Eastern white pine, jack pine, silver maple.	
Omro: OzB		Northern white-cedar, common ninebark, silky dogwood, lilac.	White spruce, Norway spruce.	Eastern white pine, red pine.	
Pinconning: Pn		Silky dogwood	Northern white-cedar, black spruce, red maple.		
Poygan: Po.					
Rock outcrop: Ra.					
Namur: [1] Rb	Manyflower cotoneaster.	Lilac	Norway spruce, Siberian peashrub.	Eastern white pine, red pine, jack pine.	
Rondeau: Rn		Late lilac, nanny-berry viburnum, common ninebark.	Japanese tree lilac	Laurel willow	Carolina poplar, almondleaf willow.
Rousseau: RoB, RoC	Vanhoutte spirea	White spruce, Tatarian honey-suckle, autumn-olive.	Eastern white pine, Austrian pine, Norway spruce.	Red pine, jack pine.	Carolina poplar.
[1] RpC: Rousseau part	Vanhoutte spirea	White spruce, Tatarian honey-suckle, autumn-olive.	Eastern white pine, Austrian pine, Norway spruce.	Red pine, jack pine.	Carolina poplar.
Shawano part	Manyflower cotoneaster.	Lilac	Norway spruce, Siberian peashrub.	Eastern white pine, red pine, jack pine.	

TABLE 4.—*Windbreaks and environmental plantings*—Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of—				
	<8	8–15	16–25	26–35	>35
[1] RpD: Rousseau part	Vanhoutte spirea	White spruce, Tatarian honeysuckle, autumn-olive.	Eastern white pine, Austrian pine, Norway spruce.	Red pine, jack pine.	Carolina poplar.
Shawano part	Manyflower cotoneaster.	Lilac	Norway spruce, Siberian peashrub.	Eastern white pine, red pine, jack pine.	
[1] RrB: Rousseau part	Vanhoutte spirea	White spruce, Tatarian honeysuckle, autumn-olive.	Eastern white pine, Austrian pine, Norway spruce.	Red pine, jack pine.	Carolina poplar.
Deford part		Nannyberry viburnum, arrowwood.	Northern white-cedar, eastern white pine, black spruce.		
Saprists: Sa.					
Sisson: SnA, SnB	Silky dogwood	Tatarian honeysuckle, Amur privet.	Laurel willow, red pine.	Eastern white pine	Green ash, Carolina poplar.
Solona: SoA		Northern white-cedar, red-osier dogwood, nannyberry viburnum.	Green ash, white spruce.	Eastern white pine, jack pine, silver maple.	
Suamico: Su		Late lilac, nannyberry viburnum, common ninebark.	Japanese tree lilac	Laurel willow	Carolina poplar, almondleaf willow.
Summerville: SvA, SvB, SvC, SvD.		Amur honeysuckle, shadblow serviceberry, Siberian crabapple.	Northern white-cedar.		
Udipsamments: Ud	Manyflower cotoneaster.	Lilac	Norway spruce, Siberian peashrub.	Eastern white pine, red pine, jack pine.	
Udorthents: Uo	Manyflower cotoneaster.	Lilac	Norway spruce, Siberian peashrub.	Eastern white pine, red pine, jack pine.	
Wainola: Wa		White spruce, silky dogwood, Tatarian honeysuckle.	Eastern white pine, northern white-cedar, Austrian pine.	Norway spruce, red pine, laurel willow.	Carolina poplar.

TABLE 4.—*Windbreaks and environmental plantings*—Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of—				
	<8	8–15	16–25	26–35	>35
Yahara: YaA		Northern white-cedar, lilac, common ninebark, silky dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine.	
Yahara Variant: Yv		Northern white-cedar, red-osier dogwood, nannyberry viburnum.	Green ash, white spruce.	Eastern white pine, jack pine, silver maple.	

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

used by wildlife. Examples are corn, sorghum, wheat, oats, barley, millet, buckwheat, cowpeas, soybeans, and sunflowers. Major soil properties that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations.

Grasses and legumes are domestic perennial grasses and herbaceous legumes that are planted for wildlife food and cover. Examples are fescue, bluegrass, lovegrass, switchgrass, bromegrass, timothy, orchardgrass, clover, alfalfa, trefoil, and crownvetch. Major soil properties that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations.

Wild herbaceous plants are native or naturally established herbaceous grasses and forbs, including weeds, that provide food and cover for wildlife. Examples are bluestem, indiangrass, goldenrod, beggarweed, pokeweed, partridgepea, wheatgrass, fescue, and grama. Major soil properties that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations.

Hardwood trees and the associated woody understory provide cover for wildlife and produce nuts or other fruit, buds, catkins, twigs, bark, or foliage that wildlife eat. Examples of native plants are oak, poplar, cherry, apple, hawthorn, dogwood, sumac, hickory, hazelnut, black walnut, blackberry, grape, blackhaw, viburnum, blueberry, bayberry, and briers. Examples of fruit-producing shrubs that are commercially available and suitable for planting on soils rated good are Russian-olive, autumn-olive, and crabapple. Major soil properties that affect growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness.

Coniferous plants are cone-bearing trees, shrubs, or ground cover that furnish habitat or supply food in the form of browse, seeds, or fruitlike cones. Examples are pine, spruce, hemlock, fir, yew, cedar, and juniper. Major soil properties that affect the growth of coniferous plants are depth of the root zone, available water capacity, and wetness.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites, exclusive of submerged or floating aquatics. They produce food or cover for wildlife that use wetland as habitat. Examples of wetland plants are smartweed, wild millet, rushes, sedges, reeds, wildrice, saltgrass, cordgrass, and cattail. Major soil properties affecting wetland plants are texture of the surface layer, wetness, reaction, slope, and surface stoniness.

Shallow water areas are bodies of surface water that have an average depth of less than 5 feet and are useful to wildlife. They can be naturally wet areas, or they can be created by dams or levees or by water-control devices in marshes or streams. Examples are muskrat marshes, waterfowl feeding areas, wildlife watering developments, beaver ponds, and other wildlife ponds. Major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. The availability of a dependable water supply is important if water areas are to be developed.

The kinds of wildlife habitat are briefly described in the following paragraphs.

Openland habitat consists of croplands, pastures, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The kinds of wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, killdeer, cottontail rabbit, red fox, and woodchuck.

Woodland habitat consists of hardwoods or conifers, or a mixture of both, and associated grasses, legumes, and wild herbaceous plants. Examples of wildlife attracted to this habitat are ruffed grouse, woodcock, thrushes, vireos, woodpeckers, tree squirrels, grey fox, raccoon, and deer.

Wetland habitat consists of water-tolerant plants in open, marshy, or swampy shallow water areas. Examples of wildlife attracted to this habitat are ducks,

TABLE 5.—*Recreational development*

["Shrink-swell" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe"]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Allendale: AdA	Severe: wetness	Moderate: wetness, too sandy.	Severe: wetness	Moderate: wetness, too sandy.
Alpena: ApC	Moderate: small stones.	Moderate: small stones.	Severe: slope	Slight.
Angelica: Ax	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.
Beaches: Be.				
Bonduel: Bn	Moderate: wetness	Moderate: wetness	Moderate: wetness, depth to rock.	Moderate: wetness.
Bonduel Shallow Variant: Bo	Moderate: wetness	Moderate: wetness	Severe: depth to rock	Moderate: wetness.
Bonduel Wet Variant: Bp	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness.
Boyer: BrB	Moderate: too sandy	Moderate: too sandy	Moderate: too sandy	Moderate: too sandy.
BrC, BrD	Moderate: too sandy	Moderate: too sandy	Severe: slope	Moderate: too sandy.
Carbondale: Ca	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.
Casco: CcB	Slight	Slight	Moderate: slope	Slight.
CcC2	Moderate: slope	Moderate: slope	Severe: slope	Slight.
Cathro: Cm	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.
Chippeny: Cp	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.
Deford: De	Severe: wetness, floods	Severe: wetness	Severe: wetness, floods.	Severe: wetness.
Duel: DuB	Moderate: too sandy	Moderate: too sandy	Moderate: depth to rock, too sandy.	Moderate: too sandy.
Duel Variant: Dv	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness.
Emmet: EmA	Slight	Slight	Slight	Slight.
EmB	Slight	Slight	Moderate: slope	Slight.
EmC2	Moderate: slope	Moderate: slope	Severe: slope	Slight.
EmD2	Severe: slope	Severe: slope	Severe: slope	Moderate: slope.
EmE	Severe: slope	Severe: slope	Severe: slope	Severe: slope.

TABLE 5.—*Recreational development*—Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Fabius: Fa	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness.
Fluvaquents: Fu	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.
Gravel pits: Gp.				
Kewaunee: KhA, KhB	Moderate: percs slowly.	Slight	Moderate: percs slowly.	Slight.
KhC2	Moderate: percs slowly.	Moderate: slope	Severe: slope	Slight.
KkD3	Severe: too clayey, slope.	Severe: slope	Severe: too clayey, slope.	Severe: too clayey.
Kiva: KmB	Slight	Slight	Moderate: slope, small stones.	Slight.
KmC	Moderate: slope	Moderate: slope	Severe: slope	Slight.
Kolberg: KoA	Moderate: percs slowly.	Slight	Moderate: percs slowly, depth to rock.	Slight.
KoB	Moderate: percs slowly.	Slight	Moderate: slope, depth to rock, percs slowly.	Slight.
KoC2	Moderate: slope, percs slowly.	Moderate: slope	Severe: slope	Slight.
Kolberg Variant: KvB	Moderate: percs slowly.	Slight	Moderate: percs slowly.	Slight.
KvC2	Moderate: percs slowly, slope.	Moderate: slope	Severe: slope	Slight.
Longrie: LoA, LoB	Slight	Slight	Moderate: depth to rock, small stones.	Slight.
LoC	Moderate: slope	Moderate: slope	Severe: slope	Slight.
Manawa: McA	Severe: floods, wetness.	Moderate: floods, wetness.	Severe: floods, wetness.	Moderate: floods, wetness.
Manistee: MeB	Moderate: too sandy	Moderate: too sandy	Severe: too sandy	Moderate: too sandy.
Markey: Mk	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.
Namur: NaB	Slight	Slight	Severe: depth to rock	Slight.
NaC	Moderate: slope	Moderate: slope	Severe: depth to rock, slope.	Slight.
Namur Variant: Nv	Severe: wetness	Severe: wetness	Severe: wetness, depth to rock.	Severe: wetness.

TABLE 5.—*Recreational development*—Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Omena:				
OmB	Slight	Slight	Moderate: slope	Slight.
OmC	Moderate: slope	Moderate: slope	Severe: slope	Slight.
OmD	Severe: slope	Severe: slope	Severe: slope	Moderate: slope.
Omena Variant:				
OvB	Moderate: wetness	Moderate: wetness	Moderate: wetness, slope.	Moderate: wetness.
Omro:				
OzB	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight.
Pinconning:				
Pn	Severe: wetness, floods.	Severe: wetness	Severe: wetness, floods.	Severe: wetness.
Poygan:				
Po	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.
Rock outcrop:				
Ra.				
Namur:				
[1] Rb	Moderate: slope	Moderate: slope	Severe: depth to rock, slope.	Slight.
Rondeau:				
Rn	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.
Rousseau:				
RoB	Moderate: soil blowing, too sandy.	Moderate: soil blowing, too sandy.	Severe: soil blowing, too sandy.	Severe: soil blowing, too sandy.
RoC	Moderate: soil blowing, slope, too sandy.	Moderate: soil blowing, slope, too sandy.	Severe: soil blowing, slope, too sandy.	Severe: soil blowing, too sandy.
[1] RpC:				
Rousseau part	Moderate: soil blowing, too sandy.	Moderate: soil blowing, too sandy.	Severe: soil blowing, slope, too sandy.	Severe: soil blowing, too sandy.
Shawano part	Moderate: too sandy, soil blowing.	Moderate: too sandy, soil blowing.	Severe: too sandy, slope.	Severe: too sandy, soil blowing.
[1] RpD:				
Rousseau part	Severe: slope	Severe: slope	Severe: soil blowing, slope, too sandy.	Severe: soil blowing, too sandy.
Shawano part	Severe: slope	Severe: slope	Severe: too sandy, slope.	Severe: too sandy, soil blowing.
[1] RrB:				
Rousseau part	Moderate: soil blowing, too sandy.	Moderate: soil blowing, too sandy.	Severe: soil blowing, too sandy.	Severe: soil blowing, too sandy.
Deford part	Severe: wetness, floods.	Severe: wetness	Severe: wetness, floods.	Severe: wetness.
Saprists:				
Sa	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.
Sisson:				
SnA	Slight	Slight	Slight	Slight.
SnB	Slight	Slight	Moderate: slope	Slight.
Solona:				
SoA	Moderate: floods, wetness.	Moderate: floods, wetness.	Severe: wetness, floods.	Moderate: wetness.

TABLE 5.—*Recreational development*—Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Suamico: Su	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.
Summerville: SvA, SvB	Slight	Slight	Severe: depth to rock.	Slight.
SvC	Moderate: slope	Moderate: slope	Severe: depth to rock, slope.	Slight.
SvD	Severe: slope	Severe: slope	Severe: depth to rock, slope.	Moderate: slope.
Udipsamments: Ud	Severe: too sandy	Severe: too sandy	Severe: too sandy	Severe: too sandy.
Udorthents: Uo	Severe: small stones	Severe: small stones	Severe: small stones	Severe: small stones.
Wainola: Wa	Severe: wetness	Moderate: wetness, too sandy.	Severe: too sandy, wetness.	Severe: too sandy.
Yahara: YaA	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness.
Yahara Variant: Yv	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

geese, herons, shore birds, rails, kingfishers, muskrat, mink, and beaver.

Engineering [6]

This section provides information about the use of the soils for building sites, sanitary facilities, construction materials, and water management. Among those who can benefit from this section are engineers, landowners, community decision makers and planners, town and city managers, land developers, builders, contractors, and farmers and ranchers.

The ratings in tables in this section are based on test data and estimated data in the "Soil properties" section. The ratings were determined jointly by soil scientists and engineers of the Soil Conservation Service using known relationships between the soil properties and the behavior of soils in various engineering uses.

Among the soil properties and site conditions identified by the soil survey and used in determining the ratings in this section are grain-size distribution, liquid limit, plasticity index, soil reaction, depth to and hardness of bedrock within 5 feet of the surface, soil wetness characteristics, depth to a seasonal water table, slope, likelihood of flooding, natural soil structure or aggregation, in-place soil density, and geologic origin of the soil material. Where pertinent, data about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of absorbed cations were also considered.

Based on the information assembled about soil properties, ranges of values may be estimated for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, shear strength, compressibility, slope stability, and other factors of expected soil behavior in engineering uses. As appropriate, these values may be applied to each major horizon of each soil or to the entire profile.

These factors of soil behavior affect construction and maintenance of roads, airport runways, pipelines, foundations for small buildings, ponds and small dams, irrigation projects, drainage systems, sewage and refuse disposal systems, and other engineering works. The ranges of values can be used to select potential residential, commercial, industrial, and recreational areas; make preliminary estimates pertinent to construction in a particular area; evaluate alternate routes for roads, streets, highways, pipelines, and underground cables; evaluate alternate sites for location of sanitary landfills, onsite sewage disposal systems, and other waste disposal facilities; plan detailed onsite investigations of soils and geology; find sources of gravel, sand, clay, and topsoil; plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; relate performance of structures already built to the properties of

[6] MICHAEL J. TIRY, civil engineer, Soil Conservation Service, assisted in the preparation of this section.

TABLE 6.—*Wildlife habitat potentials*

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates the soil was not rated]

Soil name and map symbol	Potential for habitat elements							Potential as habitat for—		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
Allendale: AdA	Fair	Fair	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
Alpena: ApC	Very poor	Very poor	Poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor.
Angelica: Ax	Good	Fair	Good	Good	Fair	Good	Good	Good	Good	Good.
Beaches: Be.										
Bonduel: Bn	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Bonduel Shallow Variant: Bo	Poor	Poor	Fair	Fair	Fair	Poor	Poor	Poor	Fair	Poor.
Bonduel Wet Variant: Bp	Fair	Good	Good	Good	Good	Good	Good	Good	Good	Good.
Boyer: BrB, BrC, BrD	Poor	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor.
Carbondale: Ca	Poor	Fair	Fair	Fair	Good	Good	Good	Fair	Fair	Good.
Casco: CcB, CcC2	Fair	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor.
Cathro: Cm	Poor	Fair	Fair	Fair	Good	Good	Good	Fair	Fair	Good.
Chippeny: Cp	Poor	Fair	Fair	Fair	Good	Good	Good	Fair	Fair	Good.
Deford: De	Poor	Poor	Fair	Good	Fair	Good	Good	Poor	Fair	Good.
Duel: DuB	Poor	Fair	Fair	Poor	Poor	Very poor	Very poor	Fair	Poor	Very poor.
Duel Variant: Dv	Fair	Fair	Fair	Poor	Poor	Poor	Poor	Fair	Poor	Poor.
Emmet: EmA, EmB	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
EmC2	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
EmD2	Poor	Fair	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
EmE	Very poor	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor.
Fabius: Fa	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good.

TABLE 6.—*Wildlife habitat potentials*—Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for—		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
Fluvaquents: Fu	Poor	Poor	Fair	Fair	Fair	Good	Fair	Poor	Fair	Fair.
Gravel pits: Gp.										
Kewaunee: KhA	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
KhB	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
KhC2	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
KkD3	Poor	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor.
Kiva: KmB	Fair	Good	Good	Fair	Fair	Poor	Very poor	Good	Fair	Very poor.
KmC	Fair	Good	Good	Fair	Fair	Very poor	Very poor	Good	Fair	Very poor.
Kolberg: KoA, KoB, KoC2	Good	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
Kolberg Variant: KvB	Poor	Fair	Fair	Poor	Poor	Poor	Poor	Fair	Poor	Poor.
KvC2	Poor	Fair	Fair	Poor	Poor	Poor	Very poor	Fair	Poor	Very poor.
Longrie: LoA, LoB	Fair	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
LoC	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
Manawa: McA	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good.
Manistee: MeB	Poor	Fair	Good	Good	Good	Poor	Very poor	Fair	Good	Very poor.
Markey: Mk	Poor	Fair	Fair	Good	Good	Good	Good	Fair	Good	Good.
Namur: NaB, NaC	Poor	Poor	Fair	Poor	Poor	Very poor	Very poor	Poor	Fair	Very poor.
Namur Variant: Nv	Very poor	Very poor	Poor	Poor	Poor	Poor	Very poor	Very poor	Poor	Very poor.
Omena: OmB	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
OmC	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
OmD	Poor	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor.
Omena Variant: OvB	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Omro: OzB	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Pinconning: Pn	Fair	Poor	Fair	Good	Fair	Good	Good	Fair	Fair	Good.

Poygan:										
Po	Good	Good	Good	Good	Fair	Good	Good	Good	Good	Good.
Rock outcrop:										
Ra.										
Namur:										
[1] Rb	Poor	Poor	Fair	Poor	Poor	Very poor	Very poor	Poor	Fair	Very poor.
Rondeau:										
Rn	Poor	Fair	Fair	Fair	Good	Good	Good	Fair	Fair	Good.
Rousseau:										
RoB	Poor	Poor	Good	Fair	Fair	Poor	Very poor	Fair	Fair	Poor.
RoC	Poor	Poor	Good	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor.
[1] RpC:										
Rousseau part	Poor	Poor	Good	Fair	Fair	Poor	Very poor	Fair	Fair	Poor.
Shawano part	Poor	Poor	Fair	Poor	Poor	Very poor	Very poor	Poor	Poor	Very poor.
[1] RpD:										
Rousseau part	Poor	Poor	Good	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor.
Shawano part	Very poor	Very poor	Fair	Poor	Poor	Very poor	Very poor	Poor	Poor	Very poor.
[1] RrB:										
Rousseau part	Poor	Poor	Good	Fair	Fair	Poor	Very poor	Fair	Fair	Poor.
Deford part	Poor	Poor	Poor	Poor	Poor	Fair	Good	Poor	Poor	Fair.
Saprists:										
Sa	Very poor	Fair	Fair	Fair	Good	Good	Good	Poor	Good	Good.
Sisson:										
SnA	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
SnB	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Solona:										
SoA	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good.
Suamico:										
Su	Fair	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
Summerville:										
SvA, SvB	Very poor	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor	Very poor	Very poor.
SvC, SvD	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor	Very poor	Very poor.
Udipsamments:										
Ud	Poor	Poor	Fair	Fair	Fair	Very poor	Very poor	Poor	Fair	Very poor.
Udorthents:										
Uo	Very poor	Poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor.
Wainola:										
Wa	Fair	Fair	Good	Good	Good	Fair	Fair	Fair	Good	Fair.
Yahara:										
YaA	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good.
Yahara Variant:										
Yv	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good.

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

the kinds of soil on which they are built so that performance of similar structures on the same or a similar soil in other locations can be predicted; and predict the trafficability of soils for cross country movement of vehicles and construction equipment.

Data presented in this section are useful for land-use planning and for choosing alternative practices or general designs that will overcome unfavorable soil properties and minimize soil-related failures. Limitations on the use of these data, however, should be well understood. First, the data are generally not presented for soil material below a depth of 5 feet. Also, because of the scale of the detailed map in this soil survey, small areas of soils that differ from the dominant soil may be included in mapping. Thus, these data do not eliminate the need for onsite investigations and testing.

The information is presented mainly in tables. Table 7 shows, for each kind of soil, ratings of the degree and kind of limitations for building site development; table 8, for sanitary facilities; and table 10, for water management. Table 9 shows the suitability of each kind of soil as a source of construction materials.

The information in the tables, along with the soil map, the soil descriptions, and other data provided in this survey can be used to make additional interpretations and to construct interpretive maps for specific uses of land.

Some of the terms used in this soil survey have different meanings in soil science and in engineering; the Glossary defines many of these terms.

Building site development

The degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets are indicated in table 7. A *slight* limitation indicates that soil properties are favorable for the specified use, and any limitation is minor and easily overcome. A *moderate* limitation indicates that soil properties and site features are unfavorable for the specified use, but the limitations can be overcome or minimized by special planning and design. A *severe* limitation indicates one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design, or intensive maintenance is required. For some soils rated severe, such costly measures may not be feasible.

Shallow excavations are used for pipelines, sewerlines, telephone and power transmission lines, basements, open ditches, and cemeteries. Such digging or trenching is influenced by the soil wetness of a high seasonal water table; the texture and consistence of soils; the tendency of soils to cave in or slough; and the presence of very firm, dense soil layers, bedrock, or large stones. In addition, excavations are affected by slope of the soil and the probability of flooding. Ratings do not apply to soil horizons below a depth of 5 feet, unless otherwise noted.

In the soil descriptions, the consistence of each soil horizon is defined, and the presence of very firm or extremely firm horizons, usually difficult to excavate, is indicated.

Dwellings and small commercial buildings referred to in table 7 are built on undisturbed soil and have foundation loads of a dwelling no more than three stories high. Separate ratings are made for small commercial buildings without basements and for dwellings with and without basements. For such structures, soils should be sufficiently stable that cracking or subsidence from settling or shear failure of the foundation does not occur. These ratings were determined from estimates of the shear strength, compressibility, and shrink-swell potential of the soil. Soil texture, plasticity and in-place density, potential frost action, soil wetness, and depth to a seasonal high water table were also considered. Soil wetness and depth to a seasonal high water table indicate potential difficulty in providing adequate drainage for basements, lawns, and gardens. Depth to bedrock, slope, and the large stones in or on the soil are also important considerations in the choice of sites for these structures and were considered in determining the ratings. Susceptibility to flooding is a serious limitation.

Local roads and streets referred to in table 7 have an all-weather surface that can carry light to medium traffic all year. They consist of a subgrade of the underlying soil material; a base of gravel, crushed rock fragments, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly of asphalt or concrete. The roads are graded with soil material at hand, and most cuts and fills are less than 6 feet deep.

The load-supporting capacity and the stability of the soil, as well as the quantity and workability of fill material available, are important in design and construction of roads and streets. The AASHTO and Unified classifications of the soil and the soil texture, density, shrink-swell potential, and potential frost action are indicators of the traffic-supporting capacity used in making the ratings. Soil wetness, flooding, slope, depth to hard rock or very compact layers, and content of large stones, all of which affect stability and ease of excavation, were also considered.

Sanitary facilities

Favorable soil properties and site features are needed for proper functioning of septic tank absorption fields, sewage lagoons, and sanitary landfills. The nature of the soil is important in selecting sites for these facilities and in identifying limiting soil properties and site features to be considered in design and installation. Also, those soil properties that deal with the ease of excavation or installation of these facilities will be of interest to contractors and local officials. Table 8 shows the degree and kind of limitations of each soil for these uses and for use of the soil as daily cover for landfills.

If the degree of soil limitation is indicated by the rating *slight,* soils are favorable for the specified use, and limitations are minor and easily overcome; if *moderate,* soil properties or site features are unfavorable for the specified use, but limitations can be overcome by special planning and design; and if *severe,* soil properties or site features are so unfavorable or difficult to overcome that major soil reclamation, special designs, or intensive maintenance are required.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into the natural soil. Only the soil horizons between depths of 18 and 60 inches are evaluated for this use. The soil properties and site features consid-

TABLE 7.—*Building site development*

["Shrink-swell" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Allendale: AdA	Severe: wetness, cutbanks cave.	Severe: wetness, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: wetness, low strength, shrink-swell.	Severe: low strength, shrink-swell.
Alpena: ApC	Severe: cutbanks cave.	Slight	Slight	Moderate: slope	Slight.
Angelica: Ax	Severe: wetness, floods.	Severe: wetness, floods, frost action.	Severe: wetness, floods.	Severe: wetness, floods, frost action.	Severe: wetness, frost action, floods.
Beaches: Be.					
Bonduel: Bn	Severe: wetness	Moderate: wetness, shrink-swell.	Severe: wetness, depth to rock.	Moderate: wetness, shrink-swell.	Severe: frost action.
Bonduel Shallow Variant: Bo	Severe: wetness, depth to rock.	Moderate: wetness, shrink-swell, depth to rock.	Severe: wetness, depth to rock.	Moderate: wetness, shrink-swell, depth to rock.	Severe: frost action.
Bonduel Wet Variant: Bp	Severe: wetness	Severe: wetness, shrink-swell.	Severe: wetness, depth to rock.	Severe: wetness, shrink-swell.	Severe: frost action, wetness.
Boyer: BrB	Severe: cutbanks cave.	Slight	Slight	Moderate: slope	Slight.
BrC, BrD	Severe: cutbanks cave.	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope.
Carbondale: Ca	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.
Casco: CcB	Severe: cutbanks cave, small stones.	Slight	Slight	Moderate: slope	Moderate: low strength.
CcC2	Severe: cutbanks cave, small stones.	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope, low strength.
Cathro: Cm	Severe: wetness, floods, cutbanks cave.	Severe: wetness, floods, frost action.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, low strength, frost action.
Chippeny: Cp	Severe: wetness, floods, excess humus.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.
Deford: De	Severe: wetness, cutbanks cave, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.

TABLE 7.—*Building site development*—Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Duel: DuB	Severe: cutbanks cave.	Slight	Moderate: depth to rock.	Slight	Slight.
Duel Variant: Dv	Severe: wetness, cutbanks cave.	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness.
Emmet: EmA	Slight	Moderate: frost action.	Slight	Moderate: frost action.	Moderate: frost action.
EmB	Slight	Moderate: frost action.	Slight	Moderate: slope, frost action.	Moderate: frost action.
EmC2	Moderate: slope	Moderate: slope, frost action.	Moderate: slope	Severe: slope	Moderate: frost action, slope.
EmD2, EmE	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Fabius: Fa	Severe: wetness, cutbanks cave.	Severe: wetness, frost action.	Severe: wetness	Severe: wetness, frost action.	Severe: wetness, frost action.
Fluvaquents: Fu	Severe: floods, wetness.	Severe: floods, frost action, wetness.	Severe: floods, wetness.	Severe: floods, frost action, wetness.	Severe: floods, frost action, wetness.
Gravel pits: Gp.					
Kewaunee: KhA	Severe: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength.
KhB	Severe: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength, slope.	Severe: low strength.
KhC2	Severe: too clayey.	Moderate: shrink-swell, low strength, slope.	Moderate: shrink-swell, low strength, slope.	Severe: slope	Severe: low strength.
KkD3	Severe: slope, too clayey.	Severe: slope	Severe: slope	Severe: slope	Severe: low strength, slope.
Kiva: KmB	Severe: cutbanks cave.	Slight	Slight	Moderate: slope	Slight.
KmC	Severe: cutbanks cave.	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope.
Kolberg: KoA	Severe: too clayey.	Moderate: low strength, shrink-swell.	Moderate: depth to rock, shrink-swell, low strength.	Moderate: low strength, shrink-swell.	Severe: low strength.
KoB	Severe: too clayey.	Moderate: low strength, shrink-swell.	Moderate: depth to rock, shrink-swell, low strength.	Moderate: low strength, shrink-swell, slope.	Severe: low strength.
KoC2	Severe: too clayey.	Moderate: low strength, shrink-swell, slope.	Moderate: depth to rock, shrink-swell, low strength.	Severe: slope	Severe: low strength.

TABLE 7.—*Building site development*—Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Kolberg Variant:					
KvB	Moderate: depth to rock.	Moderate: low strength, shrink-swell, depth to rock.	Moderate: depth to rock.	Moderate: low strength, shrink-swell, depth to rock.	Severe: low strength.
KvC2	Moderate: depth to rock, slope.	Moderate: low strength, depth to rock, slope.	Moderate: depth to rock, slope.	Severe: slope	Severe: low strength.
Longrie:					
LoA, LoB	Severe: depth to rock.	Moderate: depth to rock, frost action.	Severe: depth to rock.	Severe: depth to rock.	Moderate: depth to rock, frost action.
LoC	Severe: depth to rock.	Moderate: depth to rock, slope, frost action.	Severe: depth to rock.	Severe: slope, depth to rock.	Moderate: depth to rock, frost action.
Manawa:					
McA	Severe: wetness, too clayey, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: floods, low strength.
Manistee:					
MeB	Moderate: cutbanks cave.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.	Slight.
Markey:					
Mk	Severe: wetness, floods, cutbanks cave.	Severe: wetness, floods, frost action.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, frost action, low strength.
Namur:					
NaB	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
NaC	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
Namur Variant:					
Nv	Severe: wetness	Severe: wetness	Severe: wetness, depth to rock.	Severe: wetness	Severe: wetness.
Omena:					
OmB	Slight	Moderate: frost action.	Slight	Moderate: frost action, slope.	Moderate: frost action.
OmC	Moderate: slope	Moderate: slope, frost action.	Moderate: slope	Severe: slope	Moderate: frost action, slope.
OmD	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Omena Variant:					
OvB	Severe: wetness	Moderate: wetness.	Severe: wetness	Moderate: wetness, slope.	Severe: frost action.
Omro:					
OzB	Severe: too clayey.	Severe: low strength.	Severe: low strength.	Severe: low strength.	Severe: low strength.
Pinconning:					
Pn	Severe: floods, cutbanks cave, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.
Poygan:					
Po	Severe: wetness, floods, too clayey.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.

TABLE 7.—*Building site development*—Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Rock outcrop: Ra.					
Namur: [1] Rb	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
Rondeau: Rn	Severe: wetness, excess humus.	Severe: floods, frost action, low strength.	Severe: floods, low strength, wetness.	Severe: floods, low strength, wetness.	Severe: frost action, low strength, wetness.
Rousseau: RoB	Severe: cutbanks cave.	Slight	Slight	Moderate: slope	Slight.
RoC	Severe: cutbanks cave.	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope.
[1] RpC: Rousseau part	Severe: cutbanks cave.	Slight	Slight	Moderate: slope	Slight.
Shawano part	Severe: cutbanks cave.	Slight	Slight	Moderate: slope	Slight.
[1] RpD: Rousseau part	Severe: cutbanks cave, slope.	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Shawano part	Severe: cutbanks cave, slope.	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
[1] RrB: Rousseau part	Severe: cutbanks cave.	Slight	Slight	Moderate: slope	Slight.
Deford part	Severe: wetness, cutbanks cave, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.
Saprists: Sa	Severe: wetness, floods, excess humus.	Severe: wetness, floods, frost action.	Severe: wetness, floods, excess humus.	Severe: wetness, floods, frost action.	Severe: wetness, floods, frost action.
Sisson: SnA	Slight	Moderate: frost action.	Slight	Moderate: frost action.	Moderate: frost action, low strength.
SnB	Slight	Moderate: frost action.	Slight	Moderate: frost action, slope.	Moderate: frost action, low strength.
Solona: SoA	Severe: wetness, floods.	Severe: floods, wetness, frost action.	Severe: wetness, floods, frost action.	Severe: floods, wetness, frost action.	Severe: frost action, floods, wetness.
Suamico: Su	Severe: wetness, floods.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.
Summerville: SvA, SvB	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
SvC	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.

TABLE 7.—*Building site development*—Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Summerville:—Con. SvD	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.
Udipsamments: Ud	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
Udorthents: Uo	Severe: small stones, cutbanks cave.	Slight	Slight	Slight	Slight.
Wainola: Wa	Severe: wetness, cutbanks cave.	Severe: wetness	Severe: wetness	Severe: wetness	Moderate: wetness, frost action.
Yahara: YaA	Severe: wetness	Severe: wetness, floods, frost action.	Severe: wetness, floods, frost action.	Severe: wetness, floods, frost action.	Severe: frost action.
Yahara Variant: Yv	Severe: wetness, floods.	Severe: wetness, floods, frost action.	Severe: wetness, floods, frost action.	Severe: wetness, floods, frost action.	Severe: wetness, floods, frost action.

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

ered are those that affect the absorption of the effluent and those that affect the construction of the system.

Properties and features that affect the absorption of the effluent are permeability, depth to a seasonal high water table, depth to bedrock, and susceptibility to flooding. Stones, boulders, and a shallow depth to bedrock interfere with installation. Excessive slope may cause lateral seepage and surfacing of the effluent in down slope areas. Also, soil erosion and soil slippage are hazards where absorption fields are installed in sloping soils.

Some soils are underlain by loose sand and gravel or fractured bedrock at a depth of less than 4 feet below the tile lines. In these soils the absorption field does not adequately filter the effluent, and, as a result, ground water supplies in the area may be contaminated.

Percolation tests are performed to determine the absorptive capacity of the soil and its suitability for septic tank absorption fields. These tests should be performed during the season when the water table is highest and the soil is at minimum absorptive capacity.

In many of the soils that have moderate or severe limitations for septic tank absorption fields, it may be possible to install special systems that lower the seasonal water table or to increase the size of the absorption field so that satisfactory performance is achieved.

Sewage lagoons are shallow ponds constructed to hold sewage while bacteria decompose the solid and liquid wastes. Lagoons have a nearly level flow area surrounded by cut slopes or embankments of compacted, nearly impervious soil material. They generally are designed so that the depth of the sewage is 2 to 5 feet. Impervious soil at least 4 feet thick for the lagoon floor and sides is required to minimize seepage and contamination of local ground water. Soils that are very high in organic-matter content and those that have stones and boulders are undesirable. Unless the soil has very slow permeability, contamination of local ground water is a hazard in areas where the seasonal high water table is above the level of the lagoon floor. In soils where the water table is seasonally high, seepage of ground water into the lagoon can seriously reduce its capacity for liquid waste. Slope, depth to bedrock, and susceptibility to flooding also affect the location of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soils affect the performance of embankments.

Sanitary landfill is a method of disposing of solid waste, either in excavated trenches or on the surface of the soil. The waste is spread, compacted in layers, and covered with thin layers of soil. Landfill areas are subject to heavy vehicular traffic. Ease of excavation, risk of polluting ground water, and trafficability affect the suitability of a soil for this purpose. The best soils have a loamy or silty texture, have moderate or slow permeability, are deep to bedrock and a seasonal water table, are free of large stones and boulders, and are not subject to flooding. In areas where the seasonal water table is high, water seeps into the trenches and causes problems in excavating and filling the trenches. Also, seepage into the refuse increases the risk of pollution of ground water. Clayey soils are likely to be

TABLE 8.—*Sanitary facilities*

["Percs slowly" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and other terms used to rate soils. Absence of an entry means soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Allendale: AdA	Severe: wetness, percs slowly.	Severe: wetness, seepage.	Severe: wetness, seepage.	Severe: wetness, seepage.	Poor: too sandy, thin layer.
Alpena: ApC	Slight	Severe: seepage	Severe: seepage	Severe: seepage	Severe: too sandy, small stones, seepage.
Angelica: Ax	Severe: wetness, floods, percs slowly.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
Beaches: Be.					
Bonduel: Bn	Severe: wetness, depth to rock.	Severe: wetness, depth to rock.	Severe: depth to rock, wetness.	Severe: wetness	Poor: thin layer.
Bonduel Variant: Bo, Bp	Severe: wetness, depth to rock.	Severe: wetness, depth to rock.	Severe: wetness, depth to rock.	Severe: wetness	Poor: thin layer.
Boyer: BrB	Slight	Severe: seepage	Severe: seepage	Severe: seepage	Fair: thin layer.
BrC, BrD	Moderate: slope	Severe: seepage	Severe: seepage	Severe: seepage	Fair: thin layer.
Carbondale: Ca	Severe: wetness, floods.	Severe: wetness, excess humus, seepage.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Poor: excess humus, hard to pack, wetness.
Casco: CcB	Slight	Severe: seepage	Severe: seepage, small stones.	Severe: seepage	Poor: thin layer.
CcC2	Moderate: slope	Severe: seepage	Severe: seepage, small stones.	Severe: seepage	Poor: thin layer.
Cathro: Cm	Severe: wetness, floods.	Severe: wetness, excess humus, seepage.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Poor: excess humus, hard to pack.
Chippeny: Cp	Severe: wetness, floods.	Severe: wetness, floods, excess humus.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: excess humus, wetness.
Deford: De	Severe: wetness, floods.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Severe: wetness, seepage, floods.	Poor: seepage, too sandy, wetness.
Duel: DuB	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, seepage.	Severe: seepage	Poor: seepage, too sandy, area reclaim.
Duel Variant: Dv	Severe: wetness	Severe: wetness, seepage, depth to rock.	Severe: depth to rock, seepage, wetness.	Severe: wetness, seepage.	Poor: too sandy.
Emmet: EmA, EmB	Slight	Moderate: seepage.	Slight	Slight	Good.

TABLE 8.—*Sanitary facilities*—Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
EmC2	Moderate: slope	Severe: slope	Slight	Moderate: slope	Fair: slope.
EmD2, EmE	Severe: slope	Severe: slope	Moderate: slope	Severe: slope	Poor: slope.
Fabius: Fa	Severe: wetness	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage	Poor: thin layer.
Fluvaquents: Fu	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
Gravel pits: Gp.					
Kewaunee: KhA	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey.
KhB	Severe: percs slowly.	Moderate: slope	Severe: too clayey.	Slight	Poor: too clayey.
KhC2	Severe: percs slowly.	Severe: slope	Severe: too clayey.	Moderate: slope	Poor: too clayey.
KkD3	Severe: percs slowly, slope.	Severe: slope	Severe: too clayey.	Severe: slope	Poor: too clayey, slope.
Kiva: KmB	Slight	Severe: seepage	Severe: seepage	Severe: seepage	Poor: thin layer.
KmC	Moderate: slope	Severe: seepage, slope.	Severe: seepage	Severe: seepage	Poor: thin layer.
Kolberg: KoA, KoB	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Slight	Poor: thin layer, area reclaim.
KoC2	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Moderate: slope	Poor: thin layer, area reclaim.
Kolberg Variant: KvB	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Poor: thin layer, area reclaim.
KvC2	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope	Poor: thin layer, area reclaim.
Longrie: LoA, LoB	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Fair: thin layer, area reclaim.
LoC	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope	Fair: thin layer, area reclaim, slope.
Manawa: McA	Severe: wetness, percs slowly, floods.	Slight	Severe: wetness, too clayey, floods.	Severe: wetness, floods.	Poor: too clayey.
Manistee: MeB	Severe: percs slowly.	Moderate: slope	Severe: too clayey.	Slight	Poor: too sandy.
Markey: Mk	Severe: wetness, floods.	Severe: wetness, excess humus, seepage.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Poor: excess humus, hard to pack.

TABLE 8.—*Sanitary facilities*—Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Namur:					
NaB	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: seepage	Poor: thin layer, small stones, area reclaim.
NaC	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: seepage	Poor: thin layer, small stones, area reclaim.
Namur Variant:					
Nv	Severe: wetness, depth to rock.	Severe: wetness, depth to rock.	Severe: wetness, depth to rock.	Severe: wetness	Poor: thin layer.
Omena:					
OmB	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
OmC	Moderate: slope	Severe: slope	Slight	Moderate: slope	Fair: slope.
OmD	Severe: slope	Severe: slope	Moderate: slope	Severe: slope	Poor: slope.
Omena Variant:					
OvB	Severe: wetness	Severe: wetness	Severe: wetness	Moderate: wetness.	Good.
Omro:					
OzB	Severe: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Poor: too clayey.
Pinconning:					
Pn	Severe: floods, wetness.	Severe: floods, seepage, wetness.	Severe: floods, seepage, wetness.	Severe: floods, seepage, wetness.	Poor: too sandy, seepage, wetness.
Poygan:					
Po	Severe: wetness, percs slowly, floods.	Severe: floods	Severe: wetness, floods, too clayey.	Severe: wetness, floods.	Poor: wetness, too clayey.
Rock outcrop.					
Ra.					
Namur:					
[1] Rb	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: seepage	Poor: thin layer, small stones, area reclaim.
Rondeau:					
Rn	Severe: wetness, floods.	Severe: floods, seepage, wetness.	Severe: wetness, floods, excess humus.	Severe: wetness, floods.	Poor: excess humus, wetness.
Rousseau:					
RoB	Slight	Severe: seepage	Severe: seepage	Severe: seepage	Poor: too sandy.
RoC	Moderate: slope	Severe: seepage, slope.	Severe: seepage	Severe: seepage	Poor: too sandy.
[1] RpC:					
Rousseau part	Slight	Severe: seepage, slope.	Severe: seepage	Severe: seepage	Poor: too sandy.
Shawano part	Slight	Severe: seepage, slope.	Severe: seepage	Severe: seepage	Poor: too sandy, seepage.
[1] RpD:					
Rousseau part	Severe: slope	Severe: seepage, slope.	Severe: seepage	Severe: seepage, slope.	Poor: too sandy, slope.
Shawano part	Severe: slope	Severe: seepage, slope.	Severe: seepage	Severe: seepage, slope.	Poor: too sandy, seepage, slope.

TABLE 8.—*Sanitary facilities*—Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
[1] RrB:					
Rousseau part	Slight	Severe: seepage	Severe: seepage	Severe: seepage	Poor: too sandy.
Deford part	Severe: wetness, floods.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Severe: wetness, seepage, floods.	Poor: seepage, too sandy, wetness.
Saprists:					
Sa	Severe: wetness, floods.	Severe: excess humus, wetness, floods.	Severe: excess humus, wetness, floods.	Severe: excess humus, wetness, floods.	Poor: wetness, excess humus.
Sisson:					
SnA	Slight	Moderate: seepage.	Slight	Slight	Good.
SnB	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
Solona:					
SoA	Severe: wetness, floods.	Severe: wetness, floods.	Severe: floods, wetness.	Severe: floods, wetness.	Good.
Suamico:					
Su	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness, excess humus.
Summerville:					
SvA, SvB	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Poor: thin layer, area reclaim.
SvC	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope	Poor: thin layer, area reclaim.
SvD	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: slope	Poor: thin layer, area reclaim, slope.
Udipsamments:					
Ud	Slight	Severe: seepage	Severe: seepage, too sandy.	Severe: seepage	Poor: too sandy.
Udorthents:					
Uo	Slight	Severe: seepage, small stones.	Severe: seepage, small stones.	Severe: seepage	Poor: small stones.
Wainola:					
Wa	Severe: wetness	Severe: wetness, seepage.	Severe: wetness, seepage.	Severe: wetness, seepage.	Poor: seepage, too sandy.
Yahara:					
YaA	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness, floods.	Fair: thin layer.
Yahara Variant:					
Yv	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

sticky and difficult to spread. Sandy or gravelly soils generally have rapid permeability that might allow noxious liquids to contaminate local ground water.

Unless otherwise stated, the ratings in table 8 apply only to soil properties and features above a depth of about 5 feet. If the trench is deeper, ratings of slight or moderate may not be valid. Site investigation is needed before a site is selected.

In the area type of sanitary landfill, refuse is placed on the surface of the soil in successive layers. The limitations caused by soil texture, depth to bedrock, and stone content do not apply to this type of landfill. Soil wetness, however, may be a limitation because of difficulty in operating equipment.

Daily cover for landfill should be soil that is easy to excavate and spread over the compacted fill during both

wet and dry weather. Soils that are loamy or silty and free of stones and boulders are better than other soils. Clayey soils may be sticky and difficult to spread; sandy soils may be subject to soil blowing.

In addition to these features, the soil selected for final cover of landfills should be suitable for growing plants. In comparison with other horizons, the A horizon in most soils has the best workability, more organic matter, and the best potential for growing plants. Thus, for either the area type or trench type landfill, stockpiling material from the A horizon for use as the surface layer of the final cover is desirable.

Where it is necessary to bring in soil material for daily or final cover, thickness of suitable soil material available and depth to a seasonal high water table in soils surrounding the sites should be evaluated. Other factors to be evaluated are those that affect reclamation of the borrow areas, such as slope, erodibility, and potential for plant growth.

Construction materials

The suitability of each soil as a source of roadfill, sand, gravel, and topsoil is indicated in table 9 by ratings of good, fair, or poor. The texture, thickness, and organic-matter content of each soil horizon are important in rating soils for use as construction materials. Each soil is evaluated to the depth observed and described as the survey is made. This depth is generally about 5 feet.

Roadfill is soil material used in embankments for roads. The ratings reflect the ease of excavating and working the material and the expected performance of the material after it has been compacted and adequately drained. The performance of soil after it is stabilized with lime or cement is not considered in the ratings, but information about soil properties that determine such performance is given in the descriptions of soil series.

The ratings apply to the soil profile between the A horizon and a depth of 5 feet. It is assumed that soil horizons will be mixed during excavation and spreading. Many soils have horizons of contrasting suitability within the profile. The estimated engineering properties in table 11 provide more specific information about the nature of each horizon that can help determine its suitability for roadfill.

Soils rated *good* as a source of roadfill have low shrink-swell potential, low potential frost action, and few cobbles and stones. They are at least moderately well drained and have slopes of 15 percent or less. Soils rated *fair* have a plasticity index of less than 15 and have other limiting features, such as high shrink-swell potential, high potential frost action, steep slopes, wetness, or many stones. If the thickness of suitable material is less than 3 feet, the entire soil is rated *poor*, regardless of the quality of the suitable material.

Sand and *gravel* are used in great quantities in many kinds of construction. The ratings in table 9 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is above a depth of 5 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 11.

Topsoil is used in areas where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material in preparing a seedbed and by the ability of the soil material to sustain the growth of plants. Also considered is the damage that would result to the area from which the topsoil is taken.

Soils rated *good* have at least 16 inches of friable loamy material at their surface. They are free of stones, are low in content of gravel and other coarse fragments, and are gently sloping. These soils are naturally fertile or respond well to fertilization. They are not so wet that excavation is difficult during most of the year.

Soils rated *fair* are loose sandy soils or firm loamy or clayey soils in which the suitable material is only 8 to 16 inches thick, or soils that have large amounts of gravel or stones.

Soils rated *poor* are very sandy soils, very firm clayey soils, soils with suitable layers less than 8 inches thick, soils that have large amounts of gravel or stones, steep soils, and poorly drained soils.

Although a rating of *good* is not based entirely on high content of organic matter, a surface horizon is much preferred for topsoil because of its organic-matter content. This horizon is designated as A1 or Ap in the soil series descriptions. The absorption and retention of moisture and nutrients for plant growth are greatly increased by organic matter. Consequently, careful preservation and use of material from these horizons is desirable.

Water management

Many soil properties and site features that affect water management practices have been identified in this soil survey. In table 10 the site features that affect use are indicated for each kind of soil. This information is significant in planning, installing, and maintaining water control structures.

Pond reservoir areas hold water behind a dam or an embankment. Soils suitable for this use have low seepage potential, which is determined by the permeability and depth over fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material that is resistant to seepage, erosion, and piping and is of favorable stability, shrink-swell potential, shear strength, and compaction characteristics. Stones and organic matter in a soil downgrade the suitability of a soil for use in embankments, dikes, and levees.

An *aquifer-fed excavated pond* is a body of water created by excavating a pit or dugout into a groundwater aquifer. Excluded are ponds that are fed by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Ratings in table 10 are for ponds that are properly designed, located, and constructed. Soil properties and site features that affect aquifer-fed ponds are depth to a permanent

TABLE 9.—*Construction materials*

["Shrink-swell" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and "poor." Absence of an entry means soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Allendale: AdA	Poor: low strength, shrink-swell.	Poor: thin layer	Unsuited	Poor: too sandy.
Alpena: ApC	Good	Fair: excess fines	Good	Poor: small stones, thin layer.
Angelica: Ax	Poor: wetness, frost action.	Unsuited	Unsuited	Poor: wetness.
Beaches: Be.				
Bonduel: Bn	Poor: frost action	Unsuited	Unsuited	Fair: thin layer.
Bonduel Shallow Variant: Bo	Poor: frost action, thin layer.	Unsuited	Unsuited	Fair: thin layer, area reclaim.
Bonduel Wet Variant: Bp	Poor: frost action, wetness.	Unsuited	Unsuited	Poor: wetness.
Boyer: BrB, BrC, BrD	Good	Good	Good	Poor: too sandy.
Carbondale: Ca	Poor: excess humus, frost action, low strength.	Unsuited	Unsuited	Poor: wetness.
Casco: CcB, CcC2	Good	Good	Good	Fair: thin layer.
Cathro: Cm	Poor: excess humus, wetness, frost action.	Unsuited	Unsuited	Poor: wetness.
Chippeny: Cp	Poor: wetness, excess humus, frost action.	Unsuited	Unsuited	Poor: wetness.
Deford: De	Poor: wetness	Good	Unsuited	Poor: too sandy, wetness.
Duel: DuB	Poor: thin layer, area reclaim.	Poor: thin layer	Unsuited	Poor: too sandy.
Duel Variant: Dv	Poor: wetness	Poor: thin layer	Unsuited	Fair: thin layer.
Emmet: EmA, EmB	Fair: frost action	Unsuited	Unsuited	Fair: thin layer.
EmC2	Fair: frost action	Unsuited	Unsuited	Fair: thin layer, slope.
EmD2	Fair: frost action, slope.	Unsuited	Unsuited	Poor: slope.
EmE	Poor: slope	Unsuited	Unsuited	Poor: slope.
Fabius: Fa	Poor: wetness, frost action.	Good	Fair: excess fines	Fair: thin layer, area reclaim.

TABLE 9.—*Construction materials*—Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Fluvaquents: Fu	Poor: frost action, wetness.	Unsuited	Unsuited	Poor: wetness.
Gravel pits: Gp.				
Kewaunee: KhA, KhB	Poor: low strength	Unsuited	Unsuited	Fair: thin layer.
KhC2	Poor: low strength	Unsuited	Unsuited	Fair: thin layer, slope.
KkD3	Poor: low strength	Unsuited	Unsuited	Poor: slope.
Kiva: KmB, KmC	Good	Good	Good	Fair: small stones.
Kolberg: KoA, KoB	Poor: low strength, area reclaim.	Unsuited	Unsuited	Fair: thin layer.
KoC2	Poor: low strength, area reclaim.	Unsuited	Unsuited	Fair: thin layer, slope.
Kolberg Variant: KvB, KvC2	Poor: low strength, thin layer, area reclaim.	Unsuited	Unsuited	Fair: thin layer.
Longrie: LoA, LoB, LoC	Poor: thin layer	Unsuited	Unsuited	Fair: area reclaim, small stones.
Manawa: McA	Poor: low strength	Unsuited	Unsuited	Fair: thin layer.
Manistee: MeB	Fair: thin layer, area reclaim.	Poor: excess fines	Unsuited	Poor: too sandy.
Markey: Mk	Poor: excess humus, wetness.	Poor: excess fines	Unsuited	Poor: wetness.
Namur: NaB, NaC	Poor: thin layer, area reclaim.	Unsuited	Unsuited	Poor: thin layer, area reclaim.
Namur Variant: Nv	Poor: wetness, thin layer, area reclaim.	Unsuited	Unsuited	Poor: wetness, thin layer.
Omena: OmB	Fair: frost action	Unsuited	Unsuited	Fair: too clayey.
OmC	Fair: frost action	Unsuited	Unsuited	Fair: too clayey, slope.
OmD	Fair: frost action, slope.	Unsuited	Unsuited	Poor: slope.
Omena Variant: OvB	Poor: frost action	Unsuited	Unsuited	Good.
Omro: OzB	Poor: low strength	Unsuited	Unsuited	Fair: thin layer.
Pinconning: Pn	Poor: wetness	Poor: thin layer	Unsuited	Poor: wetness, too sandy.
Poygan: Po	Poor: wetness, low strength.	Unsuited	Unsuited	Poor: wetness.

TABLE 9.—*Construction materials*—Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Rock outcrop: Ra.				
Namur: [1] Rb	Poor: thin layer, area reclaim.	Unsuited	Unsuited	Poor: thin layer, area reclaim.
Rondeau: Rn	Poor: excess humus, wetness.	Unsuited	Unsuited	Poor: wetness.
Rousseau: RoB, RoC	Good	Good	Unsuited	Poor: too sandy.
[1] RpC: Rousseau part	Good	Good	Unsuited	Poor: too sandy.
Shawano part	Good	Good	Unsuited	Poor: too sandy.
[1] RpD: Rousseau part	Fair: slope	Good	Unsuited	Poor: too sandy, slope.
Shawano part	Fair: slope	Good	Unsuited	Poor: too sandy, slope.
[1] RrB: Rousseau part	Good	Good	Unsuited	Poor: too sandy.
Deford part	Poor: wetness	Good	Unsuited	Poor: too sandy, wetness.
Saprists: Sa	Poor: wetness, frost action, excess humus.	Unsuited	Unsuited	Poor: wetness.
Sisson: SnA, SnB	Fair: frost action, low strength, area reclaim.	Unsuited	Unsuited	Good.
Solona: SoA	Poor: frost action	Unsuited	Unsuited	Good.
Suamico: Su	Poor: wetness, low strength, excess humus.	Unsuited	Unsuited	Poor: wetness.
Summerville: SvA, SvB, SvC, SvD	Poor: area reclaim, thin layer.	Unsuited	Unsuited	Poor: thin layer, area reclaim, small stones.
Udipsamments: Ud	Good	Fair: excess fines	Unsuited	Poor: too sandy.
Udorthents: Uo	Good	Unsuited	Good	Poor: small stones.
Wainola: Wa	Fair: wetness	Good	Unsuited	Poor: too sandy.
Yahara: YaA	Poor: frost action	Unsuited	Unsuited	Good.
Yahara Variant: Yv	Poor: wetness, frost action.	Unsuited	Unsuited	Poor: wetness.

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

TABLE 10.—*Water management*

["Seepage," and some of the other terms that describe restrictive soil features are defined in the Glossary. Absence of an entry means soil was not evaluated]

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
Allendale: AdA	Seepage	Thin layer	Slow refill	Cutbanks cave	Not needed	Not needed.
Alpena: ApC	Seepage	Seepage, piping.	No water	Not needed	Not needed	Not needed.
Angelica: Ax	Favorable	Piping, low strength.	Favorable	Poor outlets, floods.	Not needed	Wetness.
Beaches: Be.						
Bonduel: Bn	Depth to rock, seepage.	Low strength, piping, thin layer.	Deep to water	Depth to rock, frost action, wetness.	Wetness, depth to rock.	Wetness, rooting depth.
Bonduel Shallow Variant: Bo	Depth to rock, seepage.	Thin layer	Deep to water	Depth to rock, frost action, wetness.	Wetness, depth to rock.	Wetness, rooting depth.
Bonduel Wet Variant: Bp	Depth to rock, seepage.	Low strength, thin layer.	Deep to water	Depth to rock, frost action, wetness.	Wetness, depth to rock.	Wetness, rooting depth.
Boyer: BrB, BrC, BrD	Seepage, slope	Seepage	No water	Not needed	Complex slope, soil blowing.	Slope.
Carbondale: Ca	Seepage	Excess humus	Favorable	Floods, wetness, cutbanks cave.	Not needed	Not needed.
Casco: CcB, CcC2	Seepage	Seepage	No water	Not needed	Rooting depth	Droughty, rooting depth.
Cathro: Cm	Seepage	Compressible, hard to pack, low strength.	Favorable	Wetness, floods, cutbanks cave.	Not needed	Not needed.
Chippeny: Cp	Depth to rock	Compressible, unstable fill, thin layer.	Favorable	Wetness, floods, depth to rock.	Not needed	Not needed.
Deford: De	Seepage	Piping, seepage.	Favorable	Cutbanks cave	Not needed	Not needed.
Duel: DuB	Depth to rock, seepage.	Seepage, piping.	No water	Not needed	Not needed	Not needed.
Duel Variant: Dv	Depth to rock, seepage.	Seepage, piping, thin layer.	No water	Cutbanks cave, depth to rock, wetness.	Wetness, piping, too sandy.	Wetness.
Emmet: EmA	Seepage	Piping	Deep to water	Not needed	Favorable	Favorable.

TABLE 10.—*Water management*—Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
EmB	Seepage	Piping	Deep to water	Not needed	Favorable	Slope, erodes easily.
EmC2, EmD2, EmE	Seepage	Piping	Deep to water	Not needed	Slope, erodes easily.	Slope, erodes easily.
Fabius: Fa	Seepage	Seepage	Deep to water	Cutbanks cave	Not needed	Not needed.
Fluvaquents: Fu	Seepage	Low strength, piping, seepage.	Favorable	Floods, wetness.	Not needed	Wetness.
Gravel pits: Gp.						
Kewaunee: KhA, KhB, KhC2, KkD3	Favorable	Shrink-swell, low strength.	No water	Not needed	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Kiva: KmB, KmC	Seepage	Seepage, piping.	No water	Not needed	Not needed	Not needed.
Kolberg: KoA, KoB, KoC2	Depth to rock, seepage.	Low strength, thin layer, shrink-swell.	No water	Not needed	Depth to rock, erodes easily, percs slowly.	Erodes easily, percs slowly, rooting depth.
Kolberg Variant: KvB, KvC2	Depth to rock	Thin layer, low strength.	No water	Not needed	Depth to rock, rooting depth.	Rooting depth, droughty.
Longrie: LoA, LoB, LoC	Depth to rock, seepage.	Thin layer, piping.	No water	Not needed	Depth to rock, complex slope.	Rooting depth.
Manawa: McA	Favorable	Shrink-swell, low strength.	Deep to water	Percs slowly, floods.	Wetness, percs slowly, rooting depth.	Wetness, percs slowly, rooting depth.
Manistee: MeB	Favorable	Unstable fill, seepage.	No water	Not needed	Soil blowing, complex slope.	Droughty, soil blowing.
Markey: Mk	Seepage	Compressible, seepage, hard to pack.	Favorable	Floods, wetness, cutbanks cave.	Not needed	Not needed.
Namur: NaB, NaC	Depth to rock, seepage.	Thin layer	No water	Not needed	Depth to rock, seepage, piping.	Droughty, rooting depth.
Namur Variant: Nv	Depth to rock, seepage.	Thin layer, low strength, piping.	Depth to rock	Depth to rock	Depth to rock, wetness.	Wetness, rooting depth.
Omena: OmB, OmC, OmD	Seepage	Piping	No water	Not needed	Slope, erodes easily.	Slope, erodes easily.
Omena Variant: OvB	Seepage	Low strength, piping.	Deep to water	Favorable	Wetness, piping.	Wetness.

TABLE 10.—*Water management*—Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
Omro: OzB	Seepage, slope	Low strength, piping, shrink-swell.	Deep to water	Not needed	Erodes easily, percs slowly, slope.	Erodes easily, percs slowly, slope.
Pinconning: Pn	Seepage	Hard to pack, unstable fill.	Slow refill	Wetness, floods.	Not needed	Not needed.
Poygan: Po	Favorable	Shrink-swell, low strength.	Slow refill	Percs slowly, wetness, floods.	Wetness, percs slowly, rooting depth.	Wetness, percs slowly, rooting depth.
Rock outcrop: Ra.						
Namur: [1] Rb	Depth to rock, seepage.	Thin layer	No water	Not needed	Depth to rock, seepage, piping.	Droughty; rooting depth.
Rondeau: Rn	Seepage	Compressible, seepage, low strength.	Favorable	Floods, cutbanks cave, wetness.	Not needed	Not needed.
Rousseau: RoB, RoC	Seepage	Seepage, piping.	No water	Not needed	Too sandy, soil blowing.	Droughty.
[1] RpC, RpD: Rousseau part	Seepage	Seepage, piping.	No water	Not needed	Too sandy, soil blowing.	Droughty.
Shawano part	Seepage	Seepage, piping, erodes easily.	No water	Not needed	Complex slope, too sandy, soil blowing.	Droughty, erodes easily, slope.
[1] RrB: Rousseau part	Seepage	Seepage, piping.	No water	Not needed	Too sandy, soil blowing.	Droughty.
Deford part	Seepage	Piping, seepage.	Favorable	Cutbanks cave	Not needed	Not needed.
Saprists: Sa	Favorable	Hard to pack, low strength, excess humus.	Favorable	Poor outlets, floods, wetness.	Not needed	Not needed.
Sisson: SnA, SnB	Seepage	Low strength, erodes easily, piping.	Deep to water	Not needed	Erodes easily, complex slope.	Erodes easily.
Solona: SoA	Seepage	Low strength, piping.	Deep to water	Floods, wetness.	Wetness	Wetness.
Suamico: Su	Favorable	Excess humus, seepage, low strength.	Favorable	Percs slowly, wetness, floods.	Wetness, percs slowly.	Wetness, percs slowly.
Summerville: SvA, SvB, SvC, SvD	Depth to rock, seepage.	Thin layer, piping.	No water	Not needed	Depth to rock, rooting depth.	Rooting depth, droughty.

TABLE 10.—*Water management*—Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
Udipsamments: Ud	Seepage, slope	Low strength, seepage, piping.	No water	Not needed	Too sandy, soil blowing, complex slope.	Droughty, slope.
Udorthents: Uo	Seepage	Seepage	No water	Not needed	Rooting depth	Droughty, rooting depth.
Wainola: Wa	Seepage	Piping, seepage.	Deep to water	Cutbanks cave	Not needed	Not needed.
Yahara: YaA	Seepage	Piping, low strength.	Deep to water	Favorable	Wetness, piping.	Wetness.
Yahara Variant: Yv	Seepage	Low strength, piping.	Deep to water	Wetness, floods, frost action.	Wetness, piping.	Wetness.

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

water table, permeability of the aquifer, quality of the water, and ease of excavation.

Drainage of soil is affected by such soil properties as permeability, texture, structure, depth to claypan or other layers that influence rate of water movement, depth to the water table, slope, stability of ditchbanks, susceptibility to flooding, alkalinity, and availability of outlets for drainage.

Terraces and diversions are embankments, or a combination of channels and ridges, constructed across a slope to intercept runoff and allow the water to soak into the soil or flow slowly to an outlet. Features that affect suitability of a soil for terraces are uniformity of slope and steepness; depth to bedrock or other unfavorable material; permeability; ease of establishing vegetation; and resistance to water erosion, soil blowing, soil slipping, and piping.

Grassed waterways are constructed to channel runoff at nonerosive velocities to outlets. Features that affect the use of soils for waterways are slope, permeability, erodibility, and suitability for permanent vegetation.

Soil properties

Extensive data about soil properties collected during the soil survey are summarized on the following pages. The two main sources of these data are the many thousands of soil borings made during the course of the survey and the laboratory analyses of samples selected from representative soil profiles in the field.

When he makes soil borings during field mapping, the soil scientist can identify several important soil properties. He notes the seasonal soil moisture condition, or the presence of free water and its depth in the profile. For each horizon, he notes the thickness; color; the texture, or the amount of clay, silt, sand, and gravel or other coarse fragments; the structure, or natural pattern of cracks and pores in the undisturbed soil; and the consistence of soil in-place under the existing soil moisture conditions. He records the root depth of existing plants; determines soil pH, or reaction; and identifies any free carbonates.

Samples of soil material are analyzed in the laboratory to verify the field estimates of soil properties and to characterize key soils, especially properties that cannot be estimated accurately by field observation. Laboratory analyses are not conducted for all soil series in the survey area, but laboratory data for many of the soil series are available from nearby areas.

Based on summaries of available field and laboratory data, and listed in tables in this section, are estimated ranges in engineering properties and classifications and in physical and chemical properties for each major horizon of each soil in the survey area. Also presented are pertinent soil and water features and engineering test data.

Engineering properties

Table 11 gives estimates of engineering properties and classifications for the major horizons of each soil in the survey area. These estimates are presented as ranges in values most likely to exist in areas where the soil is mapped.

Most soils have, within the upper 5 or 6 feet, horizons of contrasting properties. Information is presented for each of these contrasting horizons. Depth to the upper and lower boundaries of each horizon in a representative profile of each soil is indicated. More information about the range in depth and in properties of each horizon is given for each soil series in the section "Descriptions of the soils."

TABLE 11.—*Engineering properties*

[The symbol < means less than; > means greater than. Absence

Soil name and map symbol	Depth	USDA texture	Classification	
			Unified	AASHTO
	In			
Allendale:				
AdA	0–9	Loamy sand	SM	A–2–4
	9–26	Sand, loamy sand, loamy fine sand	SP, SM	A–2–4, A–3
	26–60	Silty clay, clay	CH, MH	A–7
Alpena:				
ApC	0–12	Gravelly sandy loam	SM, ML, SP–SM	A–2–4, A–4, A–1
	12–60	Stratified very gravelly sand to sand	SP, SP–SM, GP, GW	A–1
Angelica:				
Ax	0–5	Loam	ML, CL, CL–ML	A–4
	5–25	Sandy clay loam, loam, clay loam	SC, CL, SM–SC, CL–ML	A–2–4, A–6, A–4, A–2–6
	25–60	Loam, silt loam, sandy loam	ML, SM	A–2–4, A–4
Beaches:				
Be.				
Bonduel:				
Bn	0–9	Loam	ML, CL, CL–ML	A–4
	9–11	Loam, silt loam	CL, CL–ML	A–4, A–6
	11–23	Sandy clay loam, clay loam, loam	CL, SC	A–4, A–6
	23–28	Loam	CL, CL–ML	A–4, A–6
	28–60	Unweathered bedrock.		
Bonduel Shallow Variant:				
Bo	0–10	Fine sandy loam	SM, ML	A–4
	10–14	Loam	CL	A–4, A–6
	14–17	Sandy loam, loam	SM, SC, ML, CL	A–4, A–6
	17–60	Unweathered bedrock.		
Bonduel Wet Variant:				
Bp	0–3	Sapric material	Pt	A–8
	3–6	Loam	CL, ML	A–4
	6–24	Loam	CL	A–4, A–6
	24–32	Loam	CL, CL–ML	A–4, A–6
	32–60	Unweathered bedrock.		
Boyer:				
BrB, BrC, BrD	0–17	Loamy sand	SM, SM–SC	A–2
	17–33	Sandy loam, sandy clay loam, loamy sand	SM, SC, SM–SC	A–2, A–4, A–6
	33–60	Stratified sand to gravel	SP, SP–SM, GP, GP–GM	A–1, A–3, A–2–4
Carbondale:				
Ca	0–8	Sapric material	Pt	A–8
	8–60	Sapric material, hemic material	Pt	A–8
Casco:				
CcB, CcC2	0–9	Sandy loam	SM	A–4
	9–18	Clay loam, loam, sandy clay loam	SC, CL	A–6, A–7
	18–60	Sand and gravel	GP, SP, GP–GM, SP–SM	A–1, A–3, A–2
Cathro:				
Cm	0–30	Sapric material	Pt	A–8
	30–60	Sandy loam, loam, silt loam	SM, ML, SC, CL	A–4
Chippeny:				
Cp	0–27	Sapric material	Pt	
	27–38	Sandy loam, loam, silty clay loam	SM, ML, CL–ML	A–2, A–4, A–7
	38–60	Unweathered bedrock.		
Deford:				
De	0–4	Loamy fine sand	SM	A–2–4
	4–60	Fine sand, very fine sand, loamy fine sand	SM	A–2–4

and classifications

of an entry means data were not estimated. NP means nonplastic]

Fragments >3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
	4	10	40	200		
Pct					*Pct*	
0	100	95–100	50–75	10–25	----------	NP
0	100	95–100	50–70	0–20	----------	NP
0	100	90–100	90–100	75–95	50–70	20–40
0–2	50–85	40–85	20–85	5–70	0–35	NP–10
0–2	35–60	25–50	10–35	0–10	----------	NP
0–10	90–100	85–100	55–100	55–90	25–40	2–9
0–10	90–100	85–100	70–90	25–70	15–40	5–23
0–15	85–100	80–100	60–100	30–90	12–38	2–9
0	100	100	85–100	60–90	20–30	3–10
0–2	95–100	95–100	85–95	60–90	20–30	5–12
0–5	95–100	95–100	80–90	35–80	25–40	7–20
0–5	80–95	80–95	75–85	50–65	20–30	5–12
0	100	100	70–85	40–55	10–20	1–4
0–5	95–100	95–100	80–90	60–70	25–35	7–20
0–5	95–100	95–100	65–90	35–70	10–30	2–12
0						
0	100	100	85–95	60–75	20–30	3–10
0–5	95–100	95–100	80–90	60–70	25–35	7–20
0–5	80–95	80–95	75–85	50–65	20–30	5–12
0–5	95–100	65–95	45–75	15–30	<20	NP–6
0–5	80–100	65–95	55–85	10–45	10–35	NP–16
0–10	40–100	35–100	30–70	0–10	----------	NP
0						
0						
0	80–100	80–100	60–70	35–50	<20	1–4
0–5	75–100	75–100	70–100	45–70	10–35	11–25
0–10	30–100	30–90	10–90	3–10	----------	NP
0						
0	100	95–100	60–100	35–90	15–26	3–10
0–10	95–100	90–100	55–100	25–90	10–40	NP–25
0	100	95–100	65–80	20–35	----------	NP
0	100	95–100	50–80	15–35	----------	NP

TABLE 11.—*Engineering properties*

Soil name and map symbol	Depth	USDA texture	Classification	
			Unified	AASHTO
	In			
Duel:				
DuB	0–2	Loamy sand	SM	A–2–4, A–1–B
	2–28	Sand, loamy sand	SP–SM, SM, SM–SC	A–3, A–2–4, A–1–B
	28–60	Unweathered bedrock.		
Duel Variant:				
Dv	0–9	Sandy loam	SM	A–2, A–4
	9–32	Sand	SM, SP–SM	A–2, A–3
	32–60	Unweathered bedrock.		
Emmet:				
EmA, EmB, EmC2, EmD2, EmE	0–9	Sandy loam	SM, SC, SM–SC	A–2
	9–24	Sandy loam	SM, SC, SM–SC	A–2
	24–34	Loam, sandy loam, sandy clay loam	SM–SC, CL	A–2, A–4, A–6
	34–60	Sandy loam	SM, SC, SM–SC	A–2
Fabius:				
Fa	0–7	Silt loam	ML, CL, CL–ML	A–4
	7–19	Sandy loam, sandy clay loam	SC, CL	A–4, A–6
	19–60	Sand and gravel	SP, GP, SP–SM, GP–GM	A–1, A–2–4
Fluvaquents:				
Fu	0–60	Variable.		
Gravel pits:				
Gp.				
Kewaunee:				
KhA, KhB, KhC2	0–12	Silt loam	ML, CL, CL–ML	A–4
	12–28	Clay, silty clay, silty clay loam	CL, CH	A–7
	28–60	Clay, silty clay, silty clay loam	CL, CH	A–6, A–7
KkD3	0–8	Silty clay loam	CL, CH	A–7
	8–20	Clay, silty clay, silty clay loam	CL, CH	A–7
	20–60	Clay, silty clay, silty clay loam	CL, CH	A–6, A–7
Kiva:				
KmB, KmC	0–18	Sandy loam	SM, ML, SC, CL	A–2–4, A–4
	18–60	Gravelly coarse sand, coarse sand, gravelly sand.	SP–SM, SP, SW, SW–SM	A–1, A–3
Kolberg:				
KoA, KoB, KoC2	0–9	Silt loam	ML, CL, CL–ML	A–4
	9–33	Silty clay loam, silty clay, clay	CL, CH	A–6, A–7
	33–38	Loam, clay loam, gravelly loam	CL, CL–ML	A–4, A–6
	38–60	Weathered bedrock.		
Kolberg Variant:				
KvB, KvC2	0–8	Loam	ML	A–4
	8–18	Clay loam, silty clay loam, silty clay	CL	A–7
	18–60	Unweathered bedrock.		
Longrie:				
LoA, LoB, LoC	0–3	Loam	SM, ML, SC, CL	A–2–4, A–4
	3–23	Loam, fine sandy loam, sandy loam	SM, ML, CL, SC	A–2–4, A–4, A–6, A–2–6
	23–30	Loam, fine sandy loam, sandy loam	SM, ML, CL, SC	A–2–4, A–4 A–6, A–2–6
	30–60	Unweathered bedrock.		
Manawa:				
McA	0–12	Silt loam	ML, CL–ML	A–4
	12–28	Silty clay, silty clay loam, clay	CH, CL	A–6, A–7
	28–60	Silty clay, silty clay loam, clay	CH, CL	A–6, A–7
Manistee:				
MeB	0–8	Loamy sand	SM	A–2–4
	8–34	Sand, loamy sand	SP–SM, SM	A–2–4
	34–60	Clay, silty clay	CH	A–7

and classifications—Continued

Fragments >3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
	4	10	40	200		
Pct					*Pct*	
0	95–100	95–100	45–75	15–30		NP
0	95–100	95–100	45–75	5–30	<20	NP–5
0	100	100	60–70	30–40	<20	1–4
0	95–100	95–100	50–70	5–15		NP
0–5	95–100	95–100	55–70	25–35	10–25	NP–10
0–5	85–95	80–90	50–70	25–35	<25	NP–10
0–5	95–100	90–100	55–85	25–75	10–40	5–20
0–5	85–95	80–90	50–70	25–35	10–25	NP–10
0–5	95–100	90–95	70–95	55–85	25–35	2–10
0–5	90–95	70–95	70–90	40–55	25–40	8–20
0–5	50–80	25–75	10–35	0–10		NP
0	95–100	95–100	85–100	50–70	20–30	2–10
0	90–100	90–100	90–100	75–95	45–70	30–45
0	90–100	90–100	90–100	65–95	30–60	15–35
0	95–100	95–100	90–100	75–95	45–55	25–35
0	90–100	90–100	90–100	75–95	45–70	30–45
0	90–100	90–100	90–100	65–95	30–60	15–35
0–10	85–95	80–95	45–85	15–50	10–25	NP–10
10–30	50–90	40–85	20–60	0–10		NP
0	100	100	85–100	60–90	20–30	3–10
0	95–100	95–100	90–100	75–95	35–65	20–35
0	80–100	80–100	75–90	65–75	20–35	5–15
0	100	100	85–95	60–75	20–30	1–5
0	100	100	90–100	70–95	40–60	20–30
0–8	90–95	85–95	50–95	25–75	20–40	NP–10
0–8	90–95	85–95	50–95	25–75	20–40	2–19
0–8	90–95	85–95	50–95	25–75	15–27	3–12
0	100	100	100	80–90	20–30	NP–5
0	90–100	90–100	90–100	65–95	45–70	30–45
0–5	90–100	90–100	90–100	65–95	30–60	15–35
0–2	95–100	95–100	50–75	15–30		NP
0–2	95–100	95–100	50–75	10–25		NP
0	100	100	90–100	80–95	50–80	25–45

TABLE 11.—*Engineering properties*

Soil name and map symbol	Depth	USDA texture	Classification	
			Unified	AASHTO
	In			
Markey:				
Mk	0–28	Sapric material	Pt	A–8
	28–60	Sand, loamy sand	SP, SM	A–2, A–3
Namur:				
NaB, NaC	0–8	Loam	ML	A–4
	8–60	Weathered bedrock.		
Namur Variant:				
Nv	0–5	Loam	ML	A–4
	5–9	Very fine sandy loam	ML, CL–ML	A–4
	9–60	Unweathered bedrock.		
Omena:				
OmB, OmC, OmD	0–10	Sandy loam	SM, SC, SM–SC	A–2–4
	10–17	Sandy clay loam, sandy loam, clay loam	SC, CL	A–6
	17–60	Sandy loam	SM, SC, SM–SC	A–2–4
Omena Variant:				
OvB	0–7	Sandy loam	SM	A–2, A–4
	7–15	Fine sandy loam, sandy loam, loam	SM, ML, SM–SC, CL–ML	A–4, A–2
	15–60	Fine sandy loam, sandy loam	SM	A–4, A–2
Omro:				
OzB	0–6	Silt loam	CL, CL–ML	A–4
	6–30	Clay, silty clay	CH	A–7
	30–60	Loam, gravelly sandy loam, fine sandy loam	SM, SM–SC, ML, CL–ML	A–4, A–2
Pinconning:				
Pn	0–6	Loamy fine sand	SM	A–2–4
	6–30	Sand, loamy sand	SP–SM, SM	A–3, A–2–4
	30–60	Clay, sandy clay	CH, CL	A–7
Poygan:				
Po	0–12	Silty clay loam	CL, CH	A–7
	12–29	Silty clay, silty clay loam, clay	CL, CH	A–7, A–6
	29–60	Clay, silty clay	CL, CH	A–7, A–6
Rock outcrop:				
Ra.				
Namur:				
[1] Rb	0–8	Loam	ML	A–4
	8	Weathered bedrock.		
Rondeau:				
Rn	0–26	Sapric material	Pt	A–8
	26–60	Marl	OH, MH	A–8, A–5
Rousseau:				
RoB, RoC	0–6	Fine sand	SP–SM, SM	A–2–4, A–3
	6–27	Fine sand	SP, SP–SM	A–3, A–2–4
	27–60	Fine sand	SP, SP–SM	A–3
[1] RpC, [1] RpD:				
Rousseau part	0–6	Fine sand	SP–SM, SM	A–2–4, A–3
	6–27	Fine sand	SP, SP–SM	A–3, A–2–4
	27–60	Fine sand	SP, SP–SM	A–3
Shawano part	0–7	Fine sand	SP, SM	A–2
	7–24	Fine sand, very fine sand	SP, SM	A–2
	24–60	Fine sand	SP, SM	A–2
[1] RrB:				
Rousseau part	0–6	Fine sand	SP–SM, SM	A–2–4, A–3
	6–27	Fine sand	SP, SP–SM	A–3, A–2–4
	27–60	Fine sand	SP, SP–SM	A–3

and classifications—Continued

Fragments >3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
	4	10	40	200		
Pct					*Pct*	
0	100	90–100	60–75	0–20		NP
0–5	90–100	90–100	85–100	60–90	20–30	NP–5
0	100	100	85–95	60–75	20–30	1–5
0	100	100	85–95	50–65	10–19	1–5
0–10	90–100	85–100	55–65	25–35	12–25	2–9
0–15	85–100	80–100	70–90	36–65	25–30	12–16
5–20	80–95	80–90	55–65	25–35	15–25	2–8
0	100	100	60–70	30–40	10–19	1–4
0–1	95–100	95–100	65–90	30–70	<20	2–6
0–5	85–95	85–95	65–80	30–50		NP
0	95–100	95–100	85–100	65–90	20–30	5–10
0–3	90–100	90–100	85–95	80–90	70–79	45–50
0–10	65–90	65–90	45–85	30–65	<20	NP–7
0	100	95–100	50–75	15–30		NP
0	100	95–100	50–75	5–30		NP
0	100	95–100	90–100	75–95	40–60	25–35
0	100	100	90–100	75–95	45–55	25–35
0	90–100	90–100	90–100	75–95	45–70	30–45
0–5	90–100	90–100	90–100	80–100	30–55	15–45
0–5	90–100	90–100	85–100	60–90	20–30	NP–5
0						NP
0	100	95–100	80–90	60–80	50–90	NP–10
0	100	100	90–100	5–35		NP
0	100	100	90–100	5–25		NP
0	100	100	85–100	0–10		NP
0	100	100	90–100	5–35		NP
0	100	100	90–100	5–25		NP
0	100	100	85–100	0–10		NP
0	100	100	75–100	5–35		NP
0	95–100	95–100	70–100	3–35		NP
0	95–100	95–100	70–100	2–25		NP
0	100	100	90–100	5–35		NP
0	100	100	90–100	5–25		NP
0	100	100	85–100	0–10		NP

TABLE 11.—*Engineering properties*

Soil name and map symbol	Depth	USDA texture	Classification	
			Unified	AASHTO
	In			
Deford part	0–4	Loamy fine sand	SM	A–2–4
	4–60	Fine sand, very fine sand, loamy fine sand	SM	A–2–4
Saprists:				
Sa	0–60	Sapric material	Pt	
Sisson:				
SnA, SnB	0–13	Fine sandy loam	SM, ML, SC, CL	A–4
	13–33	Silt loam, very fine sandy loam	CL–ML, CL	A–4, A–6
	33–60	Stratified silt loam to fine sand	ML, CL–ML	A–4
Solona:				
SoA	0–12	Loam	ML, CL, CL–ML	A–4
	12–18	Loam, silt loam, sandy loam	CL, SC, CL–ML, SM–SC	A–2, A–4
	18–27	Clay loam, loam, sandy loam	CL, SC	A–6
	27–60	Loam, sandy loam	ML, CL, SM, SC	A–2, A–4, A–6
Suamico:				
Su	0–33	Sapric material	Pt	A–8
	33–60	Silty clay, clay, clay loam	CL, CH	A–7
Summerville:				
SvA, SvB, SvC, SvD	0–12	Loam	CL, ML, CL–ML	A–4
	12–15	Fine sandy loam, angular cobbly fine sandy loam, angular cobbly sandy loam.	SM, SC, CL, ML	A–2–4, A–4
	15–60	Unweathered bedrock.		
Udipsamments:				
Ud	0–60	Sand	SP, SM, SP–SM	A–2, A–3
Udorthents:				
Uo	0–60	Cobbly gravel	GP, GP–GM	A–1
Wainola:				
Wa	0–5	Loamy fine sand	SM	A–2–4
	5–30	Fine sand, loamy fine sand	SM	A–2–4
	30–60	Fine sand, loamy fine sand	SM	A–2–4
Yahara:				
YaA	0–17	Fine sandy loam	ML, CL–ML, SM, SM–SC	A–4
	17–60	Stratified fine sand to silt loam	ML	A–4
Yahara Variant:				
Yv	0–9	Silt loam	ML, CL–ML	A–4
	9–23	Silt loam, very fine sandy loam	CL, CL–ML	A–4
	23–42	Stratified silt to very fine sand	ML, SM, CL–ML, SM–SC	A–4
	42–60	Stratified silt to silty clay loam	CL	A–4, A–6

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

Texture is described in table 11 in standard terms used by the United States Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loam." Other texture terms used by USDA are defined in the Glossary.

The two systems commonly used in classifying soils for engineering use are the Unified soil classification system and the American Association of State Highway and Transportation Officials soil classification system (AASHTO). In table 11 soils in the survey area are classified according to both systems.

The Unified system classifies soils according to prop-

and classifications—Continued

Fragments >3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
	4	10	40	200		
Pct					*Pct*	
0	100	95–100	65–80	20–35		NP
0	100	95–100	50–80	15–35		NP
0						
0	100	100	75–95	40–75	20–40	2–10
0	100	100	90–100	60–90	14–36	5–18
0	100	95–100	75–90	75–90	20–40	NP–10
0	90–100	85–100	75–85	60–80	20–30	1–10
0–1	90–100	85–95	60–85	30–80	20–30	5–10
0–3	90–100	85–100	75–95	40–65	25–35	10–20
0–5	85–95	80–90	70–85	30–60	<24	NP–12
0						
0	100	100	90–100	70–95	40–60	25–35
0–50	95–100	95–100	85–95	60–75	<30	NP–10
0–50	95–100	95–100	55–85	25–55	<30	NP–10
0	100	100	50–70	5–15		NP
20–35	40–65	40–60	15–25	1–10		NP
0	100	95–100	55–80	20–35		NP
0	100	95–100	50–80	15–35		NP
0	100	95–100	50–80	15–35		NP
0	100	100	70–95	40–65	<30	NP–5
0	100	100	80–100	40–95		NP
0	100	100	90–100	70–90	20–30	2–7
0	100	100	85–100	50–90	20–29	5–10
0	100	100	75–100	35–10	<20	NP–5
0	100	100	95–100	85–100	25–40	10–20

erties that affect their use as construction materials (*2*). Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter, plasticity index, liquid limit, and organic-matter content. Soils are grouped into 15 classes—eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes have a dual classification symbol, for example CL–ML.

The AASHTO system classifies soils according to those properties that affect their use in highway construction and maintenance (*1*). In this system a mineral soil is classified as one of seven basic groups ranging from A–1 through A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A–1 are coarse grained and low in con-

tent of fines. At the other extreme, in group A–7, are fine grained soils. Highly organic soils are classified as A–8 on the basis of visual inspection.

When laboratory data are available, the A–1, A–2, and A–7 groups are further classified as follows: A–1–a, A–1–b, A–2–4, A–2–5, A–2–6, A–2–7, A–7–5, and A–7–6. As an additional refinement, the desirability of soils as subgrade material can be indicated by a group index number. These numbers range from 0 for the best subgrade material to 20 or more for the poorest. The AASHTO classification for soils tested in the survey area, with group index numbers in parentheses, is given in table 14. The estimated classification, without group index numbers, is given in table 11. Also in table 11 the percentage, by weight, of cobbles or the rock fragments more than 3 inches in diameter are estimated for each major horizon. These estimates are determined largely by observing volume percentage in the field and then converting it, by formula, to weight percentage.

Percentage of the soil material less than 3 inches in diameter that passes each of four standard sieves is estimated for each major horizon. The estimates are based on tests of soils that were sampled in the survey area and in nearby areas and on field estimates from many borings made during the survey.

Liquid limit and plasticity index indicate the effect of water on the strength and consistency of soil. These indexes are used in both the Unified and AASHTO systems. They are also used as indicators in making general predictions of soil behavior.

Range in liquid limit and plasticity index are estimated on the basis of test data from the survey area or from nearby areas and on observations of the many soil borings made during the survey.

Physical and chemical properties

Table 12 shows estimated values for several soil characteristics and features that affect behavior of soils in engineering uses. These estimates are given for each major horizon, at the depths indicated, in the representative profile of each soil. The estimates are based on field observations and on test data for these and similar soils.

Permeability is estimated on the basis of known relationships between the soil characteristics observed in the field—particularly soil structure, porosity, and gradation or texture—that influence the downward movement of water in the soil. The estimates are for water movement in a vertical direction when the soil is saturated. Not considered in the estimates are lateral seepage or such transient soil features as plowpans and surface crusts. Permeability of the soil is an important factor to be considered in the planning and design of drainage systems, in evaluating the potential of soils for septic tank systems and other waste disposal systems, and in many other aspects of land use and management.

Available water capacity is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are organic-matter content, soil texture, and soil structure. Shallow-rooted plants are not likely to use the available water from the deeper soil horizons. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design of irrigation systems.

Soil reaction is expressed as range in pH values. The range in pH of each major horizon is based on many field checks. For many soils, the values have been verified by laboratory analyses. Soil reaction is important in selecting the crops and ornamental or other plants to be grown, in evaluating soil amendments for fertility and stabilization, and in evaluating the corrosivity of soils.

Shrink-swell potential depends mainly on the amount and kind of clay in the soil. Laboratory measurements of the swelling of undisturbed clods were made for many soils. For others it was estimated on the basis of the kind of clay and on measurements of similar soils. Size of imposed loadings and the magnitude of changes in soil moisture content are also important factors that influence the swelling of soils. Shrinking and swelling of some soils can cause damage to building foundations, basement walls, roads, and other structures unless special designs are used. A high shrink-swell potential indicates that special design and added expense may be required if the planned use of the soil will not tolerate large volume changes.

Risk of corrosion, as used in table 12, pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to soil moisture, particle-size distribution, total acidity, and electrical conductivity of the soil material; and the rate of corrosion of concrete is based mainly on the sulfate content, soil texture, and acidity. Protective measures for steel or more resistant concrete help to avoid or minimize damage resulting from the corrosion. Installations of steel that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely within one kind of soil or one soil horizon.

Erosion factors are used to predict the erodibility of a soil and its tolerance to erosion in relation to specific kinds of land use and treatment. The soil erodibility factor (K) is a measure of the susceptibility of the soil to erosion by water. Soils having the highest K values are the most erodible. K values range from 0.10 to 0.64. To estimate annual soil loss per acre, the K value of a soil is modified by factors representing plant cover, grade and length of slope, management practices, and climate. The soil-loss tolerance factor (T) is the maximum rate of soil erosion, whether from rainfall or soil blowing, that can occur without reducing crop production or environmental quality. The rate is expressed in tons of soil loss per acre per year.

Wind erodibility groups are made up of soils that have similar properties that affect their resistance to soil blowing if cultivated. The groups are used to predict the susceptibility of soil to blowing and the amount of soil lost as a result of blowing. Soils are grouped according to the following distinctions:

1.—Sands, coarse sands, fine sands, and very fine sands. These soils are extremely erodible, so vegetation is difficult to establish. They are generally not suitable for crops.

2.—Loamy sands, loamy fine sands, and loamy very

fine sands. These soils are very highly erodible, but crops can be grown if intensive measures to control soil blowing are used.

3.—Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible, but crops can be grown if intensive measures to control soil blowing are used.

4L.—Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible, but crops can be grown if intensive measures to control soil blowing are used.

4.—Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible, but crops can be grown if measures to control soil blowing are used.

5.—Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible, but crops can be grown if measures to control soil blowing are used.

6.—Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible, and crops can easily be grown.

7.—Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible, and crops can easily be grown.

8.—Stony or gravelly soils and other soils not subject to soil blowing.

Soil and water features

Features that relate to runoff or infiltration of water, to flooding, to grading and excavation, and to subsidence and frost action of each soil are indicated in table 13. This information is helpful in planning land uses and engineering projects that are likely to be affected by the amount of runoff from watersheds, by flooding and a seasonal high water table, by the presence of bedrock in the upper feet of the soil, by subsidence, or by frost action.

Hydrologic groups are used to estimate runoff after rainfall. Soil properties that influence the minimum rate of infiltration into the bare soil after prolonged wetting are depth to water table, water intake rate and permeability after prolonged wetting, and depth to layers of slowly or very slowly permeable soil.

Flooding is rated in general terms that describe the frequency, duration, and period of the year when flooding is most likely. These terms are defined in the Glossary. The ratings are based on evidences in the soil profile of the effects of flooding, namely thin strata of gravel, sand, silt or, in places, clay deposited by floodwater; irregular decrease in organic-matter content with increasing depth; absence of distinctive soil horizons that form in soils that are not subject to flooding; local information about floodwater heights and the extent of flooding; and local knowledge that relates the unique landscape position of each soil to historic floods.

The generalized description of flood hazards is of value in land use planning and provides a valid basis for land use restrictions. The soil data are less specific, however, than those provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

A *high water table* is the highest level of a saturated zone more than 6 inches thick in soils for a continuous period of more than 2 weeks during most years. The depth to a high water table applies to undrained soils. Estimates are based mainly on the relationships between grayish colors or mottles in the soil and the depth to free water observed during the course of the soil survey. Indicated are the depth to the high water table; the kind of water table, whether perched, artesian, or the upper part of the ground water table; and the months of the year that the high water commonly is present. Only those saturated zones above a depth of 5 or 6 feet are indicated.

Information about the high water table helps in assessing the need for specially designed foundations, for specific kinds of drainage systems, and for footing drains to insure dry basements. Such information is also needed to decide whether or not to construct basements and to determine how septic tank absorption fields and other underground installations will function. Also, a high water table affects ease of excavation.

Depth to bedrock is shown for all soils that are underlain by bedrock at a depth of 5 feet or less. For many soils, limited ranges in depth to bedrock are a part of the definition of the soil series. The depths shown are based on measurements made in many soil borings and other observations during the soil mapping. The kind of bedrock and its relative hardness as related to ease of excavation is also shown. Rippable bedrock can be excavated with a single-tooth ripping attachment on a 200-horsepower tractor, but hard bedrock generally requires blasting.

Subsidence is the settlement of organic soils or of soils containing semifluid layers. Initial subsidence generally results from local drainage. Total subsidence is initial subsidence plus the slow lowering of elevation through a period of several years because of oxidation or compression of organic material.

Potential frost action refers to the likelihood of damage to pavements and other structures by frost heaving and low soil strength after thawing. Frost action is defined as freezing temperatures in the soil and movement of soil moisture into the freezing zone, which causes the formation of ice lenses. Soil texture, temperature, moisture content, porosity, permeability, and organic-matter content are the most important soil properties that affect frost action. It is assumed that the soil is not covered by insulating vegetation or snow and is not artificially drained. Silty and clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly or sandy soils are the least susceptible.

TABLE 12.—*Physical and chemical*

[The symbol < means less than; > means greater than. The erosion tolerance factor

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction
	In	*In/hr*	*In/in*	*pH*
Allendale:				
AdA	0–9	2.0–20	0.07–0.12	5.1–7.3
	9–26	6.0–20	0.06–0.10	5.1–7.3
	26–60	0.06–0.2	0.08–0.12	6.1–8.4
Alpena:				
ApC	0–12	2.0–20	0.05–0.17	6.6–7.8
	12–60	>20	0.02–0.04	7.9–8.4
Angelica:				
Ax	0–5	0.6–2.0	0.18–0.22	6.1–7.3
	5–25	0.2–0.6	0.10–0.20	6.1–7.3
	25–60	0.2–0.6	0.10–0.20	7.9–8.4
Beaches:				
Be.				
Bonduel:				
Bn	0–9	0.6–2.0	0.20–0.24	6.6–7.8
	9–11	0.6–2.0	0.17–0.22	6.6–7.8
	11–23	0.6–2.0	0.15–0.19	5.6–7.8
	23–28	0.6–2.0	0.17–0.19	6.6–8.4
	28–60			
Bonduel Shallow Variant:				
Bo	0–10	0.6–2.0	0.16–0.18	7.4–7.8
	10–14	0.6–2.0	0.17–0.19	7.4–7.8
	14–17	0.6–2.0	0.12–0.19	7.4–7.8
	17–60			
Bonduel Wet Variant:				
Bp	0–3	0.2–6.0	0.35–0.45	6.6–7.8
	3–6	0.6–2.0	0.20–0.22	6.6–7.8
	6–24	0.6–2.0	0.17–0.19	6.6–7.8
	24–32	0.6–2.0	0.17–0.19	6.6–7.8
	32–60			
Boyer:				
BrB, BrC, BrD	0–17	6.0–20	0.10–0.12	5.6–7.3
	17–33	2.0–6.0	0.12–0.18	5.6–7.8
	33–60	>20	0.02–0.04	7.4–8.4
Carbondale:				
Ca	0–8	0.2–6.0	0.35–0.45	5.6–7.8
	8–60	0.6–6.0	0.45–0.55	5.6–7.8
Casco:				
CcB, CcC2	0–9	0.6–2.0	0.13–0.15	5.6–7.3
	9–18	0.6–2.0	0.15–0.19	5.6–7.8
	18–60	>20	0.02–0.04	7.4–8.4
Cathro:				
Cm	0–30	0.2–6.0	0.45–0.55	5.6–7.8
	30–60	0.2–2.0	0.11–0.22	6.6–8.4
Chippeny:				
Cp	0–27	0.2–0.6	0.35–0.45	5.6–7.8
	27–38	0.2–2.0	0.12–0.19	6.6–8.4
	38			
Deford:				
De	0–4	6.0–20	0.07–0.09	5.6–6.0
	4–60	6.0–20	0.05–0.07	5.6–8.4
Duel:				
DuB	0–2	6.0–20	0.10–0.12	5.1–6.5
	2–28	>6.0	0.05–0.10	5.1–7.3
	28–60			

properties of soils

(T) is for the entire profile. Absence of an entry means data were not estimated]

Shrink-swell potential	Risk of corrosion		Erosion factors		Wind erodibility group
	Uncoated steel	Concrete	K	T	
Low	Low	Moderate	0.15	4	2
Low	Low	Moderate	0.15		
High	High	Low	0.32		
Very low	Low	Low	0.17	2	3
Very low	Low	Low	0.10		
Low	High	Low			5
Moderate	High	Low			
Low	High	Low			
Low	Moderate	Low	0.28	4–3	5
Low	Moderate	Low	0.28		
Moderate	Moderate	Low	0.28		
Low	Moderate	Low	0.28		
Low	Moderate	Low			3
Moderate	Moderate	Low			
Low	Moderate	Low			
Low	Moderate	Low			5
Low	Moderate	Low			
Moderate	Moderate	Low			
Low	Moderate	Low			
Low	Low	Moderate	0.17	4–3	2
Low	Low	Moderate	0.24		
Low	Low	Low	0.10		
	High	Moderate			3
	High	Moderate			
Low	Low	Low	0.32	3	3
Moderate	Low	Low	0.32		
Very low	Low	Low	0.10		
	High	Low			8
Low	High	Low			
High	High	Moderate			3
Low	High	Low			
Very low	Low	Moderate			2
Very low	Low	Low			
Very low	Low	Moderate	0.15	4	2
Very low	Low	Moderate	0.15		

TABLE 12.—*Physical and chemical*

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction
	In	*In/hr*	*In/in*	*pH*
Duel Variant:				
Dv	0–9	2.0–6.0	0.13–0.15	6.6–7.8
	9–32	6.0–20	0.06–0.08	6.6–7.8
	32–60			
Emmet:				
EmA, EmB, EmC2, EmD2, EmE	0–9	2.0–6.0	0.12–0.15	6.1–6.5
	9–24	2.0–6.0	0.08–0.12	7.4–8.4
	24–34	0.6–2.0	0.11–0.18	6.6–7.8
	34–60	2.0–6.0	0.08–0.12	7.4–8.4
Fabius:				
Fa	0–7	2.0–6.0	0.16–0.22	5.6–7.3
	7–19	2.0–6.0	0.15–0.18	5.6–7.3
	19–60	>20	0.02–0.04	7.9–8.4
Fluvaquents:				
Fu	0–60			
Gravel pits:				
Gp.				
Kewaunee:				
KhA, KhB, KhC2	0–12	0.6–2.0	0.20–0.24	5.6–7.3
	12–28	0.06–0.6	0.09–0.13	5.6–7.8
	28–60	0.2–0.6	0.08–0.20	7.4–8.4
KkD3	0–8	0.2–0.6	0.21–0.23	5.6–7.3
	8–20	0.06–0.6	0.09–0.13	5.6–7.8
	20–60	0.2–0.6	0.08–0.20	7.4–8.4
Kiva:				
KmB, KmC	0–18	0.6–2.0	0.08–0.18	6.1–7.8
	18–60	>20	0.02–0.04	7.9–8.4
Kolberg:				
KoA, KoB, KoC2	0–9	0.6–2.0	0.20–0.24	5.6–7.3
	9–33	0.06–0.6	0.09–0.20	6.6–7.8
	33–38	0.2–2.0	0.15–0.19	6.6–7.8
	38–60			
Kolberg Variant:				
KvB, KvC2	0–8	0.6–2.0	0.20–0.22	6.6–7.8
	8–18	0.2–0.6	0.11–0.20	6.6–7.8
	18–60			
Longrie:				
LoA, LoB, LoC	0–3	2.0–6.0	0.10–0.20	5.6–7.3
	3–23	0.6–6.0	0.09–0.19	5.6–7.3
	23–30	0.6–6.0	0.08–0.18	6.6–8.4
	30–60			
Manawa:				
McA	0–12	0.6–2.0	0.21–0.23	6.6–7.8
	12–28	0.06–0.2	0.09–0.20	6.1–8.4
	28–60	0.06–0.2	0.08–0.20	7.9–8.4
Manistee:				
MeB	0–8	6.0–20	0.10–0.12	5.1–6.5
	8–34	6.0–20	0.06–0.10	5.1–7.3
	34–60	0.06–0.2	0.08–0.12	5.6–8.4
Markey:				
Mk	0–28	0.2–6.0	0.35–0.45	5.6–7.8
	28–60	6.0–20	0.03–0.08	6.1–8.4
Namur:				
NaB, NaC	0–8	0.6–2.0	0.20–0.24	6.1–7.8
	8–60			

properties of soils—Continued

Shrink-swell potential	Risk of corrosion		Erosion factors		Wind erodibility group
	Uncoated steel	Concrete	K	T	
Very low	Low	Low			3
Very low	Low	Low			
Low	Low	Moderate	0.20	5–4	3
Low	Low	Low	0.32		
Moderate	Low	Low	0.32		
Low	Low	Low	0.32		
Low	Moderate	Moderate	0.28	3–2	5
Low	Moderate	Moderate	0.20		
Low	Low	Low	0.10		
					5
Low	Low	Low	0.37	3	5
Moderate	Moderate	Low	0.37		
Moderate	Moderate	Low	0.37		
Moderate	Moderate	Low	0.37	3	4
Moderate	Moderate	Low	0.37		
Moderate	Moderate	Low	0.37		
Low	Low	Low	0.24	3–2	3
Very low	Low	Low	0.10		
Low	Moderate	Moderate	0.43	3–2	5
Moderate	Moderate	Low	0.32		
Moderate	Moderate	Low	0.32		
Low	Moderate	Low	0.32	2	5
Moderate	Moderate	Low	0.32		
Very low	Low	Low	0.32	4–3	3
Very low	Low	Low	0.32		
Very low	Low	Low	0.32		
Low	Low	Low	0.37	3–2	5
Moderate	High	Low	0.37		
Moderate	High	Low	0.37		
Very low	Low	Moderate	0.17	4–3	2
Very low	Low	Moderate	0.17		
High	High	Low	0.32		
	High	Low			8
Low	High	Low			
Low	Moderate	Low	0.37	1	5

TABLE 12.—*Physical and chemical*

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction
	In	*In/hr*	*pH*	*pH*
Namur Variant:				
Nv	0–5	0.6–2.0	0.20–0.22	7.4–7.8
	5–9	0.6–2.0	0.20–0.22	7.4–7.8
	9–60			
Omena:				
OmB, OmC, OmD	0–10	2.0–6.0	0.11–0.15	6.1–7.8
	10–17	0.6–2.0	0.10–0.20	6.1–7.8
	17–60	0.6–2.0	0.08–0.12	7.4–8.4
Omena Variant:				
OvB	0–7	2.0–6.0	0.13–0.15	6.6–8.4
	7–15	0.6–2.0	0.12–0.19	6.6–8.4
	15–60	0.6–2.0	0.11–0.16	6.6–8.4
Omro:				
OzB	0–6	0.6–2.0	0.20–0.24	6.1–7.8
	6–30	0.06–0.6	0.09–0.13	6.1–7.8
	30–60	0.6–2.0	0.08–0.19	7.9–8.4
Pinconning:				
Pn	0–6	2.0–6.0	0.10–0.12	5.6–6.5
	6–30	6.0–20	0.06–0.11	6.1–7.3
	30–60	0.06–0.2	0.08–0.12	7.9–8.4
Poygan:				
Po	0–12	0.2–0.6	0.14–0.21	7.4–7.8
	12–29	0.06–0.2	0.09–0.18	6.6–7.8
	29–60	0.06–0.2	0.08–0.12	7.4–7.8
Rock outcrop:				
Ra.				
Namur:				
[1] Rb	0–8	0.6–2.0	0.20–0.24	6.1–7.8
	8			
Rondeau:				
Rn	0–26	0.2–6.0	0.35–0.48	7.4–7.8
	26–60	<0.2	0.20–0.22	7.4–7.8
Rousseau:				
RoB, RoC	0–6	6.0–20	0.07–0.09	5.1–6.0
	6–27	6.0–20	0.06–0.08	5.1–6.0
	27–60	6.0–20	0.05–0.07	5.6–6.5
[1] RpC, [1] RpD:				
Rousseau part	0–6	6.0–20	0.07–0.09	5.1–6.0
	6–27	6.0–20	0.06–0.08	5.1–6.0
	27–60	6.0–20	0.05–0.07	5.6–6.5
Shawano part	0–7	6.0–20	0.07–0.09	5.6–6.5
	7–24	6.0–20	0.06–0.08	5.1–6.5
	24–60	6.0–20	0.05–0.07	5.6–7.8
[1] RrB:				
Rousseau part	0–6	6.0–20	0.07–0.09	5.1–6.0
	6–27	6.0–20	0.06–0.08	5.1–6.0
	27–60	6.0–20	0.05–0.07	5.6–6.5
Deford part	0–4	6.0–20	0.07–0.09	5.6–6.0
	4–60	6.0–20	0.05–0.07	5.6–8.4
Saprists:				
Sa	0–60	0.2–6.0	0.35–0.45	

properties of soils—Continued

Shrink-swell potential	Risk of corrosion		Erosion factors		Wind erodibility group
	Uncoated steel	Concrete	K	T	
Low	Moderate	Low			5
Low	Moderate	Low			
Low	Low	Low	0.24	5–4	3
Moderate	Low	Low	0.32		
Low	Low	Low	0.32		
Low	Moderate	Low	0.20	5	3
Low	Moderate	Low	0.20		
Low	Moderate	Low	0.20		
Low	Moderate	Low	0.43	3–2	5
Moderate	High	Low	0.32		
Low	High	Low	0.32		
Low	High	Moderate			2
Low	High	Low			
High	High	Low			
Moderate	High	Low	0.37	3–2	7
Moderate	High	Low	0.37		
Moderate	High	Low	0.37		
Low	Moderate	Low	0.37	1	5
	High	Low			8
	High	Low			
Very low	Low	High	0.15	5	1
Very low	Low	Moderate	0.15		
Very low	Low	Moderate	0.15		
Very low	Low	High	0.15	5	1
Very low	Low	Moderate	0.15		
Very low	Low	Moderate	0.15		
Low	Low	Moderate	0.15	5	1
Low	Low	High	0.15		
Low	Low	Moderate	0.15		
Very low	Low	High	0.15	5	1
Very low	Low	Moderate	0.15		
Very low	Low	Moderate	0.15		
Very low	Low	Moderate			2
Very low	Low	Low			
Low					

TABLE 12.—*Physical and chemical*

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction
	In	*In/hr*	*In/in*	*pH*
Sisson:				
SnA, SnB	0–13	0.6–2.0	0.16–0.24	6.1–7.3
	13–33	0.6–2.0	0.18–0.22	6.1–7.8
	33–60	0.6–2.0	0.12–0.22	7.4–8.4
Solona:				
SoA	0–12	0.6–2.0	0.20–0.24	6.6–7.8
	12–18	0.6–2.0	0.12–0.22	6.6–7.8
	18–27	0.6–2.0	0.12–0.19	7.4–7.8
	27–60	0.6–2.0	0.11–0.19	7.4–7.8
Suamico:				
Su	0–33	2.0–6.0	0.35–0.45	6.0–7.3
	33–60	<0.06	0.08–0.20	6.6–8.4
Summerville:				
SvA, SvB, SvC, SvD	0–12	0.6–2.0	0.18–0.22	7.4–8.4
	12–15	0.6–2.0	0.06–0.16	7.4–8.4
	15–60			
Udipsamments:				
Ud	0–60	6.0–20	0.06–0.08	5.1–6.5
Udorthents:				
Uo	0–60	>20	0.02–0.04	
Wainola:				
Wa	0–5	6.0–20	0.10–0.12	5.1–6.5
	5–30	6.0–20	0.06–0.11	5.1–6.5
	30–60	6.0–20	0.05–0.07	5.6–6.5
Yahara:				
YaA	0–17	0.6–2.0	0.15–0.22	6.6–7.8
	17–60	0.6–2.0	0.14–0.16	7.9–8.4
Yahara Variant:				
Yv	0–9	0.6–2.0	0.22–0.24	6.6–7.8
	9–23	0.6–2.0	0.17–0.22	6.6–7.8
	23–42	0.6–2.0	0.11–0.22	6.6–7.8
	42–60	0.6–2.0	0.18–0.22	7.4–8.4

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

Engineering test data

The results of analyses of engineering properties of several representative soils of the survey area are given in table 14 (See page 122).

The data presented are for soil samples that were collected from carefully selected sites. The soil profiles sampled are representative of the series discussed in "Descriptions of the soils." The soil samples were analyzed by the Wisconsin Department of Transportation, Division of Highways.

The methods that were used in obtaining the data are listed by code in the next paragraph. Most of the codes, in parentheses, refer to the methods codes assigned by the American Association of State Highway and Transportation Officials (*1*). The codes for shrinkage and the Unified classification are those assigned by the American Society for Testing and Materials (*2*). The methods and codes are AASHTO classification (M–145–66); Unified classification (D–2487–66T); mechanical analysis (T88–57); liquid limit (T89–60); plasticity index (T98–56); and moisture-density, method A (T99–57).

Formation of the soils

This section discusses factors that have affected the formation of soils in Door County. The soil series represented in this county and a representative profile for each series are described in the section "Descriptions of the soils."

Soil is produced by soil-forming processes that act on materials deposited or accumulated by geologic agencies. The characteristic of the soil at any given point are determined by (1) the climate under which

properties of soils—Continued

Shrink-swell potential	Risk of corrosion		Erosion factors		Wind erodibility group
	Uncoated steel	Concrete	K	T	
Low	Low	Low	0.20	5–4	3
Low	Low	Low	0.32		
Low	Low	Low	0.32		
Low	High	Low	0.28	5	5
Low	High	Low	0.28		
Low	High	Low	0.28		
Low	High	Low	0.37		
	Moderate	Moderate			8
Moderate	Moderate	Low			
Very low	Low	Low	0.24	2	5
Very low	Low	Low	0.24		
Very low	Low	High	0.15	5	1
Very low			0.10	5	8
Low	Low	Moderate	0.15	5	2
Low	Low	Moderate	0.15		
Low	Low	Moderate	0.15		
Low	Moderate	Low	0.32	5	3
Low	Moderate	Low	0.43		
Low	High	Low			5
Low	High	Low			
Low	High	Low			
Low	High	Low			

the soil material has accumulated and existed since accumulation; (2) the plants and animals on and in the soil; (3) the relief, or lay of the land; (4) the physical and mineralogical composition of the parent material; and (5) the length of time the forces of soil formation have acted on the soil material.

Climate and plants and animals, chiefly plants, are active factors in soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons.

The five factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are still unknown.

Climate

Climate greatly influences the formation of soils because it not only affects the weathering processes, but also determines the kinds of plants and animals in an area and controls the rate of plant growth. Door County has a cool, humid, continental type of climate in which temperature varies greatly from summer to winter. During winter the soil-forming processes are largely inactive, although some alternate freezing and thawing continue.

Plants and animals

Plants and animals affect the formation of soil by providing organic matter and by transferring plant nutrients from the lower layers of the soil to the upper

TABLE 13.—*Soil and*

[Absence of an entry indicates the feature is not a concern. See text for descriptions of symbols and

Soil name and map symbol	Hydrologic group	Flooding		
		Frequency	Duration	Months
Allendale: AdA	B	Rare		
Alpena: ApC	A	None		
Angelica: Ax	B/D	Frequent	Long	Nov-May
Beaches: Be.				
Bonduel: Bn	C	None		
Bonduel Shallow Variant: Bo	D	None		
Bonduel Wet Variant: Bp	C	None		
Boyer: BrB, BrC, BrD	B	None		
Carbondale: Ca	D	Frequent	Long	Nov-May
Casco: CcB, CcC2	B	None		
Cathro: Cm	D	Frequent	Long	Nov-May
Chippeny: Cp	D	Frequent	Long	Nov-May
Deford: De	A/D	Frequent	Brief	Mar-Apr
Duel: DuB	A	None		
Duel Variant: Dv	D	None		
Emmet: EmA, EmB, EmC2, EmD2, EmE	B	None		
Fabius: Fa	B	Rare		
Fluvaquents: Fu	D	Frequent	Very long	Mar-Nov
Gravel pits: Gp.				
Kewaunee: KhA, KhB, KhC2, KkD3	C	None		
Kiva: KmB, KmC	B	None		
Kolberg: KoA, KoB, KoC2	B	None		

water features

such terms as "rare," "brief," and "perched." The symbol < means less than; > means greater than]

High water table			Bedrock		Subsidence	Potential frost action
Depth	Kind	Months	Depth	Hardness	Total	
Ft			*In*		*In*	
0.5–1.5	Apparent	Nov-May	>60			Moderate.
>6.0			>60			Low.
0–1.0	Apparent	Oct-Jun	>60			High.
1.0–3.0	Apparent	Sep-Jun	20–40	Rippable		High.
1.0–3.0	Apparent	Sep-Jun	10–20	Rippable		Moderate.
0–1.0	Apparent	Sep-Jun	20–40	Rippable		High.
>6.0			>60			Low.
0–1.0	Apparent	Sep-May	>60			High.
>6.0			>60			Low.
0–1.0	Apparent	Nov-Jun	>60		19–22	High.
0–1.0	Apparent	Sep-May	20–51	Rippable	15–18	High.
0–1.0	Apparent	Jan-May	>60			Moderate.
>6.0			20–40	Rippable		Low.
0–3.0	Apparent	Sep-Jun	24–40	Rippable		Moderate.
>2.5			>60			Moderate.
1.5–2.0	Apparent	Nov-May	>60			High.
0–1.0	Apparent	Jan-Dec	>60			High.
>3.0	Perched	Nov-May	>60			Moderate.
>6.0			>60			Low.
>6.0			20–40	Rippable		Moderate.

TABLE 13.—*Soil and*

Soil name and map symbol	Hydrologic group	Flooding		
		Frequency	Duration	Months
Kolberg Variant: KvB, KvC2	C	None		
Longrie: LoA, LoB, LoC	C	None		
Manawa: McA	C	Occasional	Brief	Nov-May
Manistee: MeB	A	None		
Markey: Mk	D	Frequent	Long	Nov-May
Namur: NaB, NaC	D	None		
Namur Variant: Nv	D	None		
Omena: OmB, OmC, OmD	B	None		
Omena Variant: OvB	C	None		
Omro: OzB	C	None		
Pinconning: Pn	D	Common	Long	Nov-Apr
Poygan: Po	D	Frequent	Long	Nov-Jun
Rock outcrop: Ra.				
Namur: [1] Rb	D	None		
Rondeau: Rn	D	Frequent	Long	Nov-May
Rousseau: RoB, RoC	A	None		
[1] RpC, [1] RpD: Rousseau part	A	None		
Shawano part	A	None		
[1] RrB: Rousseau part	A	None		
Deford part	A/D	Frequent	Brief	Mar-Apr
Saprists: Sa	D	Frequent	Very long	Mar-Nov
Sisson: SnA, SnB	B	None		
Solona: SoA	B	Occasional	Brief	Apr-Jun

water features—Continued

High water table			Bedrock		Subsidence	Potential frost action
Depth	Kind	Months	Depth	Hardness	Total	
Ft			*In*		*In*	
>6.0			12–20	Rippable		Moderate.
>6.0			20–40	Hard		Moderate.
1.0–3.0	Perched	Nov-Jun	>60			High.
>2.5			>60			Low.
0–1.0	Apparent	Nov-Jun	>60		25–30	High.
>6.0			5–12	Hard		Moderate.
1.0–3.0	Apparent	Nov-Jun	5–10	Rippable		Low.
>6.0			>60			Moderate.
1.0–3.0	Apparent	Sep-May	>60			High.
>3.0	Apparent	Nov-May	>60			Moderate.
0–1.0	Apparent	Dec-May	>60			Moderate.
0–1.0	Perched	Nov-Jul	>60			High.
>6.0			5–12	Hard		Moderate.
0–1.0	Apparent	Jan-Dec	>60		35	High.
>2.5	Apparent	Mar-May	>60			Low.
>2.5	Apparent	Mar-May	>60			Low.
>6.0			>60			Low.
>2.5	Apparent	Mar-May	>60			Low.
0–1.0	Apparent	Jan-May	>60			Moderate.
+3–1.0	Apparent	Jan-Dec	>60			High.
>6.0			>60			Moderate.
1.0–3.0	Apparent	Mar-Jul	>60			High.

TABLE 13.—*Soil and*

Soil name and map symbol	Hydrologic group	Flooding		
		Frequency	Duration	Months
Suamico: Su	D	Frequent	Very long	Nov-May
Summerville: SvA, SvB, SvC, SvD	C	None		
Udipsamments: Ud	A	None		
Udorthents: Uo		None		
Wainola: Wa	A	Rare		
Yahara: YaA	B	Rare		
Yahara Variant: Yv	D	Frequent	Brief	Mar-May

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

layers. They also affect changes in the structure and porosity of the soils.

Forest trees were the original vegetation in the survey area. Many of the soils in the central and northern parts formed under coniferous forest. These soils are classified as Spodosols. Some examples are Emmet, Longrie, and Rousseau soils. Other soils formed under deciduous forest in young calcareous parent material. These soils are classified as Alfisols. Some examples are Kewaunee, Kolberg, and Omena.

Relief

The effects of climate and plants and animals on the soil are conditioned by relief. The topography of the county ranges from nearly level in large depressions to steep on upland moraines. In depressions, runoff is slow and internal drainage generally is slow. Soils in these areas remain wet and cool. Consequently, they develop mottles throughout their profiles, and they develop a thick surface layer that is high in organic-matter content because decomposition of surface litter is slow. Examples are soils in the Angelica, Poygan, and Solona series.

Soils that formed in alluvium are along streams. They receive fresh deposits of silt, clay, and sand at a rate faster than their horizons can develop, so their profiles do not exhibit specific horizons as in older soils. Fluvaquents is an example of this kind of soil.

Typical upland soils are those in the Emmet, Kewaunee, Longrie, and Omena series. Their profiles show distinct horizons throughout. On some steep soils, however, erosion may remove one or two of the upper horizons and alter the physical nature of the soils.

Parent material

Parent material is the unconsolidated mass in which the soils formed. It affects the kind of soil profile and determines it almost entirely in some places. The parent material of most soils in Door County was deposited by glaciers or by melt waters as the glaciers receded from this part of Wisconsin. However, the parent material of some of the soils that are along streams is recent alluvium. In organic soils the parent material consists of plant remains that accumulated and were preserved under water in swamps or shallow lakes. The nature of the parent material affects the texture, mineral composition, and chemical properties of the soil that formed in it.

The parent material of most of the soils in the southwestern part of the county consists of calcareous, reddish brown, clayey glacial drift. Kewaunee, Kolberg, Manawa, and Poygan soils formed in this. Thickness of this parent material over bedrock ranges from less than 1 foot near the Niagara escarpment to more than 100 feet. It is believed that the calcareous, reddish brown clayey glacial drift parent material correlates with the two creeks forest bed, which is about 11,400 years old (*5*).

The parent material of soils in other parts of Door County is stony, calcareous, brown, loamy glacial drift. Thickness ranges from less than 1 foot near the Niagara escarpment to more than 100 feet in the south-

water features—Continued

High water table			Bedrock		Subsidence	Potential frost action
Depth	Kind	Months	Depth	Hardness	Total	
Ft			*In*		*In*	
0–1.0	Apparent	Nov-May	>60		25–30	High.
>6.0			10–20	Hard		Moderate.
>6.0			>60			Low.
>6.0			>60			Low.
1.0–2.0	Apparent	Nov-May	>60			Moderate.
1.0–3.0	Apparent	Nov-May	>60			High.
0–1.0	Apparent	Apr-Jun	>60			High.

eastern part of the county. Emmet, Longrie, and Omena series are examples of these soils.

Time

Time is needed for the transformation of parent material into a soil. It may be much or little, but time is always required for horizon differentiation. Soils can have a profile that is well developed, that is poorly developed, or that is somewhere in between, depending on the length of time the soil-forming factors have been active. Emmet and Kewaunee soils, for example, have moderately distinct horizons and are considered to be fairly mature. However, soils that formed in recently deposited alluvium, such as Fluvaquents, show little or no profile development.

Classification of the soils

This section defines the current system of classifying soils, and classifies the soils of the area according to that system.

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Readers interested in further details about the system should refer to the latest literature available (*4, 7*).

The system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the bases for classification are the different soil properties that can be observed in the field or those that can be inferred either from other properties that are observable in the field or from the combined data of soil science and other disciplines. The properties selected for the higher categories are the result of soil genesis or of factors that affect soil genesis. In table 15 the soils of the survey area are classified according to the system. Classes of the system are briefly discussed in the following paragraphs.

ORDER. Ten soil orders are recognized. The properties used to differentiate among orders are those that reflect the kind and degree of dominant soil-forming processes that have taken place. Each order is identified by a word ending in *sol.* An example is Mollisol.

SUBORDER. Each order is divided into suborders that are based primarily on properties that influence soil genesis, that are important to plant growth, or that were selected to reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquoll (*Aqu,* meaning water, plus *oll,* from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of expression of pedogenic horizons; soil moisture and temperature regimes; and base status. The name of a great group ends with the name of the suborder. A prefix added to the name suggests something about the properties of the soil. An example is Haplaquolls (*Hapl,* meaning simple horizons, plus *aquoll,* the suborder of Mollisols that have an aquic moisture regime).

SUBGROUP. Each great group is divided into three

TABLE 14.—*Engineering*

[Tests performed by Wisconsin Department of Transportation, Division of Highways, and in cooperation with the Federal

Soil name and location	Parent material	Report number	Depth	Moisture density[1]	
				Maximum	Optimum
			In	*lb/ft³*	*Pct*
Angelica loam:					
SW¼SE¼ sec. 28, T. 26 N., R. 25 E. (Modal)	Loamy glacial till	S71WI-15-1			
		1-1	17-25		
		1-2	35-39		
Emmet sandy loam:					
NW¼NE¼ sec. 6, T. 26 N., R. 26 E. (Modal)	Loamy glacial till	S71WI-15-5			
		5-1	20-26		
		5-2	30-60	132.4	8.4
Kiva gravelly loam:					
NE¼SE¼ sec. 15, T. 32 N., R. 28 E. (Surface layer has more coarse fragments than modal)	Glacial outwash	S71WI-15-2			
		2-1	5-13		
		2-2	32-36		
Kolberg silt loam:					
NE¼SE¼ sec. 35, T. 27 N., R. 23 E. (Modal)	Loamy glacial till over limestone bedrock.	S71WI-15-3			
		3-1	22-28		
		3-2	33-38		
Longrie loam:					
SW¼SW¼ sec. 29, T. 29 N., R. 26 E. (Modal)	Loamy glacial till	S71WI-15-4			
		4-1	8-14		
		4-2	23-30		
Rousseau fine sand:					
NW¼NW¼ sec. 23, T. 26 N., R. 27 E. (Modal)	Outwash sands	S71WI-15-6			
		6-1	7-13		
		6-2	52-56	102.9	15.4

[1] Based on AASHTO Designation T99-57, Method A (*1*).

[2] Mechanical analysis according to the AASHTO Designation T88-57 (*1*). Results by this procedure may differ somewhat from the results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHTO procedure, the fine material is analyzed by hydrometer method, and the various grain-size fractions are calculated on the basis of all material up to and including that 3 inches in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method, and the material coarser than 2 millimeters in diameter is excluded from the calculation of grain-size fraction. The mechanical analysis data used in this table are not suitable for use in naming textural classes of soil.

subgroups: the central (typic) concept of the great group, which is not necessarily the most extensive subgroup; the intergrades, or transitional forms to other orders, suborders, or great groups; and the extragrades, that have some properties that are representative of the great group but do not indicate transitions to any other known kind of soil. The names of subgroups are derived by placing one or more adjectives before the name of the great group. The adjective *Typic* is used for the subgroup that is thought to typify the great group. An example is Typic Haplaquolls.

FAMILY. Families are established within a subgroup on the basis of similar physical and chemical properties that affect management. Among the properties considered in horizons of major biological activity below a plow depth are particle-size distribution, mineral content, temperature regime, thickness of the soil penetrable by roots, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for the soil properties used as family differentiae. An example is fine, mixed, mesic Typic Haplaquolls.

SERIES. The series consists of a group of soils that are formed from a particular kind of parent material and have horizons that, except for texture of the surface soil, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition.

Factors affecting soil use

This section gives information about the chief natural and cultural features that affect the use and management of the soils in Door County. It is not intended to be a full description of the county but does explain briefly those features that affect the existing and potential use of soils for farming and other purposes.

test data

Highway Administration, Department of Transportation. Absence of an entry indicates that no determination was made]

Percentage passing sieve—[3]			Percentage smaller than—[3]				Liquid limit	Plasticity index	Classification	
No. 10	No. 40	No. 200	0.05 mm	0.02 mm	0.005 mm	0.002 mm			AASHTO [3]	Unified [4]
							Pct			
95	88	71	66	54	34	23	22.5	8.9	A–4 (7)	CL
80	72	52	46	34	20	13	17.3	4.3	A–4 (3)	CL–ML
94	81	50	45	37	28	24	24.2	9.3	A–4 (3)	CL
81	70	39	33	22	13	10	15.4	[5] NP	A–4 (1)	SM
84	38	27	26	18	9	5	----------	NP	A–2–4 (0)	SM
14	10	6	5	3	1	1	----------	NP	A–1–a (0)	GM–GW
100	98	87	83	71	50	37	38.0	20.0	A–6 (12)	CL
84	79	71	64	42	24	17	20.8	5.8	A–4 (7)	CL–ML
88	72	44	39	33	26	24	30.9	14.2	A–6 (3)	SC
67	59	40	32	13	5	3	----------	NP	A–4 (1)	SM
100	83	3	3	3	3	2	----------	NP	A–3 (0)	SP
100	82	2	2	2	2	1	----------	NP	A–3 (0)	SP

[3] Based on AASHTO Designation M145–49 (*1*).
[4] Based on the Unified soil classification system (*2*).
[5] NP means nonplastic.

Relief and drainage

Door County is a peninsula with a unique geography. It is 75 miles long and ranges from 3 miles wide in the north to 15 miles wide at the southern boundary. Green Bay and Lake Michigan are separated by Door County.

About 75 percent of the county consists of somewhat poorly drained, moderately well drained, and well drained soils on glacial till plains. Approximately 8 percent of the soils formed on outwash plains and moraine ridges and about 2 percent formed on lacustrine plains. The remaining 15 percent consists of poorly drained and very poorly drained soils that formed in depressions. These depressions are scattered throughout the county.

The mean elevation of Lake Michigan is 580 feet above sea level. An elevation of 851 feet above sea level is recorded for Brussel hill in the Town of Brussels, and this is believed to be the highest point in the county.

The Niagara escarpment, which forms an almost continuous bluff along the Green Bay shoreline, rises as high as 200 feet above the bay in some places (fig. 12).

Long oval hills of glacial drift, called drumlins, are in Liberty Grove and Nasewaupee Townships. Those in Liberty Grove run north-northwest, and those in Nasewaupee run northwest. The elevation of these features is less than 50 feet above the surrounding plain.

In Union Township there is a long, winding, and steep-sided ridge, called an esker, that crosses the county line in section 36. An esker is an irregular-crested ridge of water-sorted drift deposited by a glacial stream flowing in an ice tunnel or an open crack in the ice (*5*). The esker in Union Township has been for many years a source of sand and gravel.

Ahnapee River watershed, located in the southern half of the survey area, is the largest in the county. Approximately 107 square miles of land drains into this river which flows from the eastern part of Gardner Township to its mouth in Algoma, Kewaunee

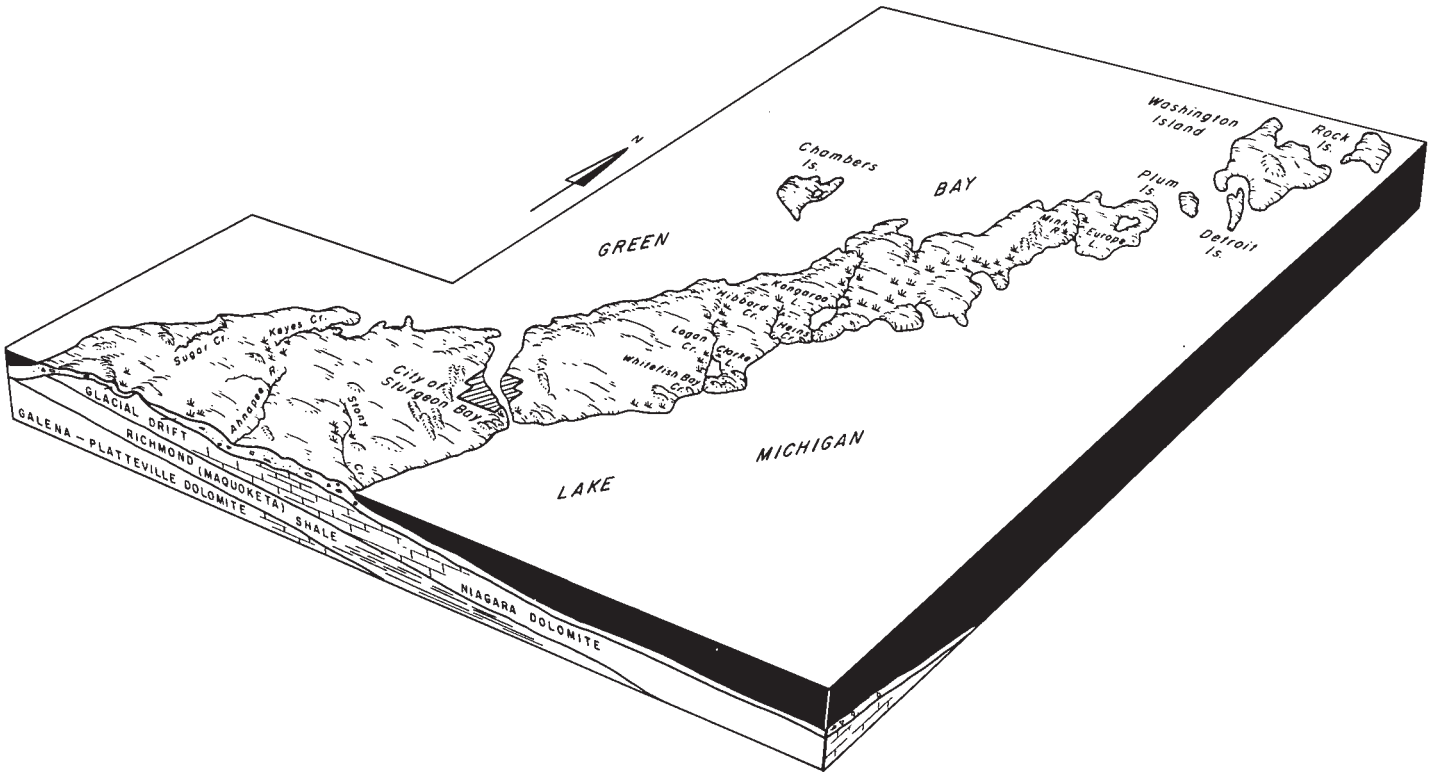

Figure 12.—**Physiography, drainage, and geology of Door County, Wisconsin.**

County. There are many smaller creeks that flow into Green Bay and Lake Michigan from the southern half of the county.

Kangaroo, Clark, and Europe lakes are inland lakes of the county. They were once bays along Lake Michigan. Beach ridges across the mouths of these bays have caused them to become inland lakes. Small streams provide outlets for Clark and Kangaroo lakes into Lake Michigan. Europe lake is landlocked.

Mink River drains much of Liberty Grove township in the north and empties into Rowleys Bay. Small, short streams drain most of the northern part of Door County into Lake Michigan. Water flows only a few miles from most points before reaching the lake. Door County contains 3,370 acres of streams and inland lakes.

Geology

The landscape of Door County is dominated basically by the Niagara Dolomite, which is of Silurian age. A Niagara escarpment appears as an almost continuous bluff along the Green Bay shoreline on the western side of the survey area. The Maquoketa Shale underlies the Niagara Dolomite and is exposed in many places along the Green Bay shoreline in the southern portion of the county. There are a number of quarries in the Niagara formation. Earlier quarries were sources of building materials and possibly of agricultural lime. Quarries now in operation provide crushed dolomite for highway construction and riprap for breakwater construction.

The Niagara Dolomite has many natural crevices and fissures. These crevices present problems for certain uses of soils that are underlain by dolomite. For example, the danger of ground water pollution from unfiltered septic tank effluent moving down these crevices is a serious hazard. Where crevices in the dolomite are large, soil material has filled or partially filled these openings. This material provides a source of plant nutrients and moisture to native vegetation.

There is also a danger of ground water contamination through sinkholes in the underlying dolomite. These sinkholes are scattered throughout the county.

Glaciation has eroded the dolomite bedrock, resulting in drift that has many dolomite fragments and a high lime content. In many areas the dolomite bedrock is very close to the surface. In other areas glacial drift is more than 100 feet thick. These deep deposits commonly occur as drumlins or as recessional and end moraines. Two basic types of glacial till are in the survey area. The loam and sandy loam till, comprising the parent materials of Emmet and Omena soils, are deposits of Cary age (*5*). The silty clay or clay loam till of Kewaunee soils are more recent deposits of Valders age.

Glacial deposits have blocked the drainage patterns of the county resulting in relatively large inland and shoreline swamps.

Many areas near the shorelines of Lake Michigan and Green Bay have been altered by wave action of

TABLE 15.—*Classification of the soils*

[An asterisk in the first column indicates a taxadjunct to the series; a double asterisk, special information. See text for characteristics of the taxadjunct that are outside the range of the series or for special information]

Soil name	Family or higher taxonomic class
*Allendale	Sandy over clayey, mixed, frigid Aqualfic Haplorthods
Alpena	Sandy-skeletal, mixed Udorthentic Haploborolls
Angelica	Fine-loamy, mixed, nonacid, frigid Aeric Haplaquepts
Bonduel	Fine-loamy, mixed Aquic Eutroboralfs
Bonduel Shallow Variant	Loamy, mixed Lithic Eutroboralfs
Bonduel Wet Variant	Fine-loamy, nonacid, frigid Typic Haplaquepts
*Boyer	Coarse-loamy, mixed, mesic Typic Hapludalfs
Carbondale	Euic Hemic Borosaprists
*Casco	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludalfs
Cathro	Loamy, mixed, euic Terric Borosaprists
Chippeny	Euic Lithic Borosaprists
Deford	Mixed, frigid Typic Psammaquents
Duel	Sandy, mixed, frigid Entic Haplorthods
Duel Variant	Sandy, mixed, frigid Typic Haplaquolls
Emmet	Coarse-loamy, mixed, frigid Alfic Haplorthods
*Fabius	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Aquic Argiudolls
Fluvaquents	Loamy, mixed, mesic Fluvaquents
*Kewaunee	Fine, mixed, mesic Typic Hapludalfs
Kiva	Sandy, mixed, frigid Entic Haplorthods
Kolberg	Fine, mixed Glossic Eutroboralfs
Kolberg Variant	Clayey, mixed Lithic Eutroboralfs
Longrie	Coarse-loamy, mixed, frigid Entic Haplorthods
*Manawa	Fine, mixed, mesic Aquollic Hapludalfs
*Manistee	Sandy over clayey, mixed, frigid Alfic Haplorthods
Markey	Sandy or sandy-skeletal, mixed, euic Terric Borosaprists
Namur	Loamy, mixed Lithic Haploborolls
Namur Variant	Loamy, mixed, frigid Lithic Haplaquolls
Omena	Coarse-loamy, mixed Typic Eutroboralfs
Omena Variant	Coarse-loamy, mixed Aquic Eutroboralfs
*Omro	Clayey over loamy, mixed, mesic Typic Hapludalfs
*Pinconning	Sandy over clayey, mixed, nonacid, frigid Mollic Haplaquents
*Poygan	Fine, mixed, mesic Typic Haplaquolls
Rondeau	Marly, euic Limnic Borosaprists
Rousseau	Sandy, mixed, frigid Entic Haplorthods
Saprists	Euic Borosaprists
Shawano	Mixed, frigid Typic Udipsamments
*Sisson	Fine-loamy, mixed, mesic Typic Hapludalfs
Solona	Fine-loamy, mixed Aquic Eutroboralfs
**Suamico	Clayey, mixed, euic Terric Borosaprists
Summerville	Loamy, mixed, frigid Entic Lithic Haplorthods
Udipsamments	Mixed, frigid Udipsamments
Udorthents	Sandy-skeletal, mixed, frigid Udorthents
Wainola	Sandy, mixed, frigid Entic Haplaquods
*Yahara	Coarse-loamy, mixed, mesic Aquic Hapludolls
Yahara Variant	Coarse-silty, mixed (calcareous), frigid Typic Haplaquolls

post-glacial great lakes. Ancient beach deposits as high as 80 feet above current lake elevation are on Washington and Rock Islands. In these areas there are inactive sand dunes and abandoned beach ridges of gravel and cobbles.

Soils on glacial till and cobbly outwash have many surface stones. Many areas that were cleared for crops are bordered by stone fences up to 10 feet wide and several feet high. These stones were picked from cropland over a period of several years. Additional stones are exposed each year by tillage, frost heave, and soil loss caused by erosion.

Climate [7]

The climate of Door County is continental, although it is modified considerably by Green Bay and Lake Michigan. This modification is reflected in the fewer number of days with extremely high and low temperatures than is common for the latitude. Spring and early summer are delayed by the surrounding cool water; mild and pleasant summers prevail; the first freeze in fall is delayed by the now relatively warm lake. Higher average cloudiness and lower percentage of sunshine also reflect the lake influence.

Thunderstorms occur on an average of 33 days a year; the number of days ranges from 19 to 46. Hail falls on an average of 2 days a year; the number of days ranges from 0 to 6.

Approximately 55 percent of the average yearly precipitation falls between May and September. The likelihood of 1 inch or more of rain in a 7-day period is greater during the first half of June and third week of August than at any other time in summer; the probability is 3 times in 10 years. The likelihood of a 7-day dry period, a trace or less of rain, is greater at the end

[7] By MARVIN W. BURLEY, former state climatologist, National Weather Service, U.S. Department of Commerce.

of August than any other time in summer; the probability is 2 times in 10 years. Rainfall intensities of about 1.10 inches in 1 hour, 1.70 inches in 6 hours, and 2.30 inches in 24 hours can be expected about once in 2 years. The greatest amount of rain in a 24-hour period was 4.57 inches on August 25, 1910. Annual snowfall has ranged from 12 inches in 1958 to 74 inches in 1959.

Observations of wind, sunshine, and humidity are not recorded at Sturgeon Bay; but data from Green Bay should be representative. Prevailing winds are from the northwest and the southwest except in early spring, when northeast winds are dominant. The months with the strongest winds are April and November with average windspeed of 12 miles per hour. The percentage of possible sunshine has averaged about 40 percent for November and December and 60 percent or more for May through September. The remaining months average between 50 and 60 percent. Relative humidity in winter ranges from an average nighttime maximum of about 80 percent to a daytime minimum of about 70 percent. Humidity in summer averages 85 percent at night and 60 percent in the daytime.

Table 16 gives temperature and precipitation data for Door County. Table 17 shows the probability of the last freezing temperature in spring and the first in fall.

The average date of the last 32° freeze in spring is May 17, and the first in fall is October 2. The growing season, defined as the number of days between the last 32° F freeze in spring and the first in fall, averages 137 days. However, the growing season designation can be misleading because different crops have different temperatures at which growth is affected. The number of days with temperature of 0° or below in one year has ranged from 3 in 1931 to 38 in 1936. The number of days with temperature of 90° or above has ranged from 0 in 1954 to 13 in 1955. About one year in three has fewer than 3 days with temperature of 90° or higher.

Water supply

The principal sources of water in Door County are the glacial drift mantle and the underlying Niagara Dolomite (*9*). Water can generally be obtained from gravel seams in the drift where the drift attains a thickness of 30 to 40 feet or more.

Niagara Dolomite is highly fissured, which allows for a great amount of water movement within the formation. Many seeps and springs are near the Green Bay shoreline where the impermeable Maquoketa Shale, which underlies the Niagara Dolomite, is close to the surface. These springs are useful to farmers as a source of water for livestock.

Door County also has a potential surface water supply in Lake Michigan and Green Bay. Presently there is little use of these as sources of water.

Natural vegetation

The survey area originally was extensively forested with black spruce, eastern hemlock, white-cedar, white pine, and mixed hardwoods such as sugar maple, red maple, black ash, and American beech. Approximately 110,000 acres, or 35 percent of the county, remains in woodland.

The wetlands in the survey area support canarygrass, marsh grasses and sedges, and water-tolerant trees and shrubs such as American elm, tamarack, dogwood, and white-cedar. Most wetlands remain in native vegetation.

History

In 1634 Jean Nicolet was the first white explorer to land in Door County. Door County was opened for settlement in 1831. The first permanent settlers on the peninsula were Increase Claflin and his family. He settled near Little Sturgeon Bay and traded with the Indians for furs. In 1850 the first farming settlers moved into the county and settled in the Ephraim and Sturgeon Bay areas. Between 1860 and 1870 the population of Door County increased from 2,948 to 4,919 because of the rapid inflow of immigrants. On October 9, 1871, a forest fire ravaged the entire southern half of the county.

Lumbering, fishing, and shipbuilding became big business in Door County during the last half of the 19th century. Around the turn of the century, cherry and apple production was established. Today these orchards add to the economy, and their esthetic beauty is one of the reasons for heavy tourism. In 1880 the Sturgeon Bay ship canal was opened. This encouraged commerce and was instrumental in the growth of the shipbuilding industry at Sturgeon Bay.

Transportation

At one time, Door County was served by the Ahnapee and Western Railroad. Service was discontinued and the line was abandoned about 1966. There is scheduled bus service to Green Bay and Milwaukee.

Three public airports are maintained in Door County. The largest of these is the Door County Airport at Sturgeon Bay. Charter and scheduled summer flights connect with Green Bay and other cities. Smaller public airports that provide charter service are located at Ephraim, Fish Creek, and Washington Island. Two private airstrips in the survey area are at Egg Harbor and Chambers Island.

Door County is traversed by two 2-lane state highways totalling about 100 miles. They are Highway 57 from Green Bay and Highway 42 from Algoma. County trunk highways, mostly blacktop surfaced, total about 260 miles. There also are about 770 miles of township highways and 40 miles of city streets in the county, most of which are blacktop surface roads.

Schools

There are five high schools in Door County. They are Southern Door, Sturgeon Bay, Sevastopol, Gibraltar, and Washington Island. There are two parochial elementary schools at Sturgeon Bay and another at Institute.

There are no colleges in Door County. The nearest, about 40 miles from Sturgeon Bay, is the University of Wisconsin, Green Bay. St. Norberts College, located at De Pere, is about 50 miles from Sturgeon Bay. The northeast Wisconsin Technical Institute at Sturgeon Bay provides vocational training to residents of Door County.

TABLE 16.—*Temperature and precipitation*

[All data from Sturgeon Bay, Wisconsin, based on records 1930–1959]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	2 years in 10 monthly average will be—		Average total	1 year in 10 will have—		Days with 0.1 inch or more precipitation	Average snowfall
			Equal to or higher than—	Equal to or lower than—		Less than—	More than—		
	°F	°F	°F	°F	In	In	In		In
January	26.7	10.4	22	13	1.19	0.47	2.04	4	10.0
February	28.3	10.2	22	17	1.30	0.43	2.63	3	9.0
March	36.5	19.2	31	25	1.73	0.76	3.04	4	8.1
April	50.8	31.9	44	39	2.35	0.92	3.73	6	1.7
May	63.4	41.0	55	50	2.65	1.13	4.47	7	0.5
June	74.0	51.2	64	60	3.07	1.56	4.72	6	0
July	80.1	57.4	70	67	2.87	1.44	4.76	6	0
August	77.5	56.8	69	65	3.00	0.95	5.09	6	0
September	69.1	49.5	60	56	3.18	1.47	4.99	7	(1)
October	57.5	39.7	51	45	2.17	0.78	4.48	5	0.1
November	42.0	28.1	37	31	2.30	0.95	3.63	5	3.3
December	30.8	17.1	27	20	1.39	0.51	2.19	4	7.6
Year	53.1	34.4	—	—	27.20	22.27	33.35	63	40.3

[1] Trace, an amount too small to measure.

TABLE 17.—*Freeze dates in spring and fall*

[All data from Sturgeon Bay, Wisconsin, based on records 1930–1959]

Probability	Dates for given probability and temperature				
	16° F or lower	20° F or lower	24° F or lower	28° F or lower	32° F or lower
Spring:					
2 years in 10 later than	April 5	April 15	April 27	May 10	May 27
4 years in 10 later than	March 29	April 8	April 20	May 3	May 20
6 years in 10 later than	March 23	April 1	April 13	April 27	May 14
8 years in 10 later than	March 15	March 24	April 6	April 20	May 8
Fall:					
2 years in 10 earlier than	November 14	November 3	October 22	October 8	September 22
4 years in 10 earlier than	November 21	November 11	October 30	October 15	September 29
6 years in 10 earlier than	November 28	November 17	November 5	October 22	October 5
8 years in 10 earlier than	December 5	November 25	November 13	October 29	October 12

Industry

Shipbuilding is the leading industry in Door County. In 1974 more than 1,200 persons were employed by shipbuilding and related industries at Sturgeon Bay.

Other large industries in the county manufacture electric motors, shoes, wire brackets, and other metal products. The processing of the cherry crop grown in the county also provides seasonal employment to many people.

Land use trends [8]

The 1970 census indicated a population of 20,106 in Door County. In 1950 the population was 20,870, and in 1960 it was 20,685. Projections show that the number will decrease slightly further by 1985. These figures, however, are for permanent residents. It is estimated that summer residents and tourists total

[8] By RAYMOND E. HOAGUE, district conservationist, Soil Conservation Service.

Figure 13.—**Residential development on former farmland of gently sloping Emmet soils.**

75,000 or more per week. Land use for summer and vacation homes is expected to increase.

The number of small farms is decreasing as larger units take over much of the land. The total number of farms likewise is decreasing and the average acreage increasing. Washington Island Township currently has no dairy farming.

The trend in land use for fruit enterprises is downward. The acreage in fruit trees was 8,500 in 1973, 10,800 in 1970, 13,100 in 1960, 12,640 in 1950, and 11,600 in 1940.

This soil survey can provide important basic data and aid in making needed inventories, so land can be used wisely and projected orderly developments can be carried out. Soil information has been widely used in the past for conservation planning in Door County. In this way, farmers especially have been helped to bring about the full production potential of their land.

Developments for purposes other than farming, such as recreational, residential, and commercial uses, are taking place, with some increase in all townships (fig. 13). This survey can help in planning, land development, and zoning. The desirability for proper land use cannot be overrated.

Private sewage treatment and disposal systems are a concern on approximately 70 percent of the soils in the survey area. There is an increased awareness of pollution and health-related problems and the need to improve the environment and maintain the "quality of life" in this rural setting. This soil survey can play a vital role in reducing pollution problems, as well as in avoiding developments in areas that are not well suited. It can also have a positive effect on the resource base for sustained use.

Literature cited

(1) American Association of State Highway [and Transportation] Officials. 1970. Standard specifications for highway materials and methods of sampling and testing. Ed. 10, 2 vol., illus.
(2) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D 2487–69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.
(3) Beatty, M. T., E. A. Brickbauer, A. J. Klingelhoets, and D. A. Rohweder. 1966. Wheat yields from Wisconsin soils. Univ. of Wis. Ext. Service, Special Cir. 65, 19 pp.
(4) Simonson, Roy W. 1962. Soil classification in the United States. Sci. 137: 1027–1034.
(5) Thwaites, F. T. and Kenneth Bertrand. 1957. Pleistocene geology of the Door Peninsula, Wisconsin. Geol. Soc. Am. Bull. 68: 831–880.
(6) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. [Supplements replacing pp. 173–188 issued May 1962]
(7) United States Department of Agriculture. 1960. Soil classification, a comprehensive system, 7th approximation. Soil Conserv. Serv., 265 pp., illus. [Supplements issued March 1967, September 1968, April 1969]
(8) United States Department of Agriculture. 1961. Land capability classification. U.S. Dept. Agric. Handb. 210, 21 pp.
(9) Weidman, Samuel and Alfred R. Schulta. 1915. The underground and surface water supplies of Wisconsin. Wis. Geol. and Nat. Hist. Surv. Bull. No. 35 (Econ. Ser. No. 17) 664 pp., illus.
(10) Wisconsin Department of Agriculture. 1973. Agriculture statistics of Wisconsin. Wis. Stat. Reporting Service. 74 pp., illus.
(11) Wisconsin Department of Nature Resources. [N.D.]. Wisconsin forest resource statistics, Lake Michigan survey report. 33 pp., illus.

Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.
Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.
Area reclaim. An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.
Association, soil. A group of soils geographically associated in

a characteristic repeating pattern and defined and delineated as a single mapping unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	More than 12

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to frequent flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coat, clay skin.

Coarse fragments. Mineral or rock particles up to 3 inches (2 millimeters to 7.5 centimeters) in diameter.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures is difficult.

Complex, soil. A mapping unit of two or more kinds of soil occurring in such an intricate pattern that they cannot be shown separately on a soil map at the selected scale of mapping and publication.

Compressible. Excessive decrease in volume of soft soil under load.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cutbanks cave. Unstable walls of cuts made by earthmoving equipment. The soil sloughs easily.

Depth to rock. Bedrock at a depth that adversely affects the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly previous layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophysic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Erosion. The wearing away of the land surface by running water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes a bare surface.

Esker (geology). A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Excess fines. Excess silt and clay. The soil does not provide a source of gravel or sand for construction purposes.

Fast intake. The rapid movement of water into the soil.

Favorable. Favorable soil features for the specified use.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Flooding. The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Frequency, duration, and probable dates of occurrence are

estimated. Frequency is expressed as none, rare, occasional, and frequent. None means that flooding is not probable; rare that it is unlikely but possible under unusual weather conditions; occasional that it occurs on an average of once or less in 2 years; and frequent that it occurs on an average of more than once in 2 years. Duration is expressed as very brief if less than 2 days, brief if 2 to 7 days, and long if more than 7 days. Probable dates are expressed in months; November–May, for example, means that flooding can occur during the period November through May. Water standing for short periods after rainfall or commonly covering swamps and marshes is not considered flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forage. Plant material used as feed by domestic animals. Forage can be grazed or cut for hay.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action. Freezing and thawing of soil moisture. Frost action can damage structures and plant roots.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also the assorted and unassorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by melt water as it flows from glacial ice.

Glacial till (geology). Unassorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rocks up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material from 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Green manure (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table, which is the upper limit of saturation.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. The major horizons of mineral soil are as follows:

O horizon.—An organic layer, fresh and decaying plant residue, at the surface of a material soil.

A horizon.—The mineral horizon, formed or forming at or near the surface, in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon most of which was originally part of a B horizon.

A2 horizon.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that from which the solum is presumed to have formed. If the material is known to differ from that in the solum the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered, but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Landslide. The rapid downhill movement of a mass of soil and loose rock generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones. Rock fragments 10 inches (25 centimeters) or more across. Large stones adversely affect the specified use.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Low strength. Inadequate strength for supporting loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Miscellaneous areas. Areas that have little or no natural soil, are too nearly inaccessible for orderly examination, or cannot otherwise be feasibly classified.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Types are terminal, lateral, medial, and ground.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—few, common, and many; size—fine, medium, and coarse: and contrast—faint, distinct, and prominent. The size measurements are the diameter along the greatest dimension. Fine indicates less than 5 millimeters (about 0.2 inch); medium, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and coarse, more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material mixed with mineral soil material. The content of organic matter is more than 20 percent.

Munsell notation. A designation of color by degrees of the three single variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3.

Organic matter. A general term for plant and animal material, in or on the soil, in all stages of decomposition. Readily decomposed organic matter is often distinguished from the more stable forms that are past the stage of rapid decomposition. Terms used to define organic matter content in percent are as follows:

Class	*Percent organic matter*
Very low	less than 0.5 percent
Low	0.5 to 1 percent
Moderately low	1 to 2 percent
Medium	2 to 4 percent
High	4 to 8 percent
Very high	greater than 8 percent

Parent material. The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Percolation. The downward movement of water through the soil.

Percs slowly. The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves through the soil. Terms describing permeability are very slow (less than 0.06 inch), slow (0.06 to 0.20 inch), moderately slow (0.2 to 0.6 inch), moderate (0.6 to 2.0 inches), moderately rapid (2.0 to 6.0 inches), rapid (6.0 to 20 inches), and very rapid (more than 20 inches).

Phase, soil. A subdivision of a soil series or other unit in the soil classification system based on differences in the soil that affect its management. A soil series, for example, may be divided into phases on the bases of differences in slope, stoniness, thickness, or some other characteristic that affects management. These differences are too small to justify separate series.

pH value. (See Reaction, soil). A numerical designation of acidity and alkalinity in soil.

Piping. Moving water forms subsurface tunnels or pipelike cavities in the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from a semisolid to a plastic state.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Poorly graded. Refers to soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity (soil). The capability of a soil for producing a specified plant or sequence of plants under a specified system of management. Productivity is measured in terms of output, or harvest, in relation to input.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH		pH
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Rooting depth. Shallow root zone. The soil is shallow over a layer that greatly restricts roots. See **Root zone.**

Root zone. The part of the soil that can be penetrated by plant roots.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeter in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Seepage. The rapid movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils, formed from a particular type of parent material, having horizons that, except for the texture of the A or surface horizon, are similar in all profile characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Letters	*Percent*	*Description*
A	0–2	Nearly level
B	2–6	Gently sloping
C	6–12	Sloping
D	12–20	Moderately steep
E	20–30	Steep
F	30+	Very steep

Slow intake. The slow movement of water into the soil.

Slow refill. The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones. Rock fragments 3 to 10 inches (7.5 to 25 centimeters) in diameter. Small stones adversely affect the specified use.

Soil. A natural, three-dimensional body at the earth's surface that is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: very coarse sand (2.0 millimeters to 1.0 millimeter); coarse sand (1.0 to 0.5 millimeter); medium sand (0.5 to 0.25 millimeter); fine sand (0.25 to 0.10 millimeter); very fine sand (0.10 to 0.05 millimeter); silt (0.005 to 0.002 millimeter); and clay (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stratified. Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining aggregates. The principal forms of soil structure are—platy (laminated), prismatic (vertical axis of aggregates longer than horizontal), columnar (prisms with rounded tops), blocky (angular or subangular), and granular. Structureless soils are either single grained (each grain by itself, as in dune sand) or massive (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use or management.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. A stream terrace is frequently called a second bottom, in contrast with a flood plain, and is seldom subject to overflow. A marine terrace, generally wide, was deposited by the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer. Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The condition of the soil, especially the soil structure, as related to the growth of plants. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil (engineering). Presumably a fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Unstable fill. Risk of caving or sloughing in banks of fill material.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but the limited geographic soil area does not justify creation of a new series.

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and the description of the soil series to which the mapping unit belongs. In referring to a capability unit or a woodland suitability subclass, read the introduction to the section it is in for general information about its mangement.

Map symbol	Mapping unit	Described on page	Capability unit		Woodland suitability subclass
			Symbol	Page	Symbol
AdA	Allendale loamy sand, 0 to 3 percent slopes	6	IIIw-6	51	3o
ApC	Alpena gravelly sandy loam, 0 to 12 percent slopes	8	VIs-5	54	4f
Ax	Angelica loam	9	IIw-1	48	3w
Be	Beaches	9	VIIIs-10	54	6s
Bn	Bonduel loam	10	IIw-3	49	3o
Bo	Bonduel Shallow Variant fine sandy loam	10	IVw-5	52	4w
Bp	Bonduel Wet Variant loam	11	IIw-3	49	4w
BrB	Boyer loamy sand, 2 to 6 percent slopes	12	IIIs-4	51	3o
BrC	Boyer loamy sand, 6 to 12 percent slopes	12	IIIe-7	50	3o
BrD	Boyer loamy sand, 12 to 20 percent slopes	12	IVe-7	52	3r
Ca	Carbondale muck	13	IVw-9	53	3w
CcB	Casco sandy loam, 2 to 6 percent slopes	14	IIIe-3	50	3d
CcC2	Casco sandy loam, 6 to 12 percent slopes, eroded	14	IVe-3	52	3d
Cm	Cathro muck	15	IVw-7	52	3w
Cp	Chippeny muck	15	VIIs-10	54	3w
De	Deford loamy fine sand	16	IVw-5	52	4w
DuB	Duel loamy sand, 1 to 6 percent slopes	16	IVs-3	52	3s
Dv	Duel Variant sandy loam	17	IVw-5	52	4w
EmA	Emmet sandy loam, 0 to 2 percent slopes	18	IIs-1	48	2o
EmB	Emmet sandy loam, 2 to 6 percent slopes	18	IIe-2	47	2o
EmC2	Emmet sandy loam, 6 to 12 percent slopes, eroded	18	IIIe-2	50	2o
EmD2	Emmet sandy loam, 12 to 20 percent slopes, eroded	18	IVe-2	52	2r
EmE	Emmet sandy loam, 20 to 35 percent slopes	18	VIe-2	53	2r
Fa	Fabius silt loam	20	IIIw-5	51	3o
Fu	Fluvaquents	20	Vw-14	53	4w
Gp	Gravel pits	20	NG 1/	--	NG
KhA	Kewaunee silt loam, 0 to 2 percent slopes	21	IIs-8	48	2c
KhB	Kewaunee silt loam, 2 to 6 percent slopes	21	IIe-6	48	2c
KhC2	Kewaunee silt loam, 6 to 12 percent slopes, eroded	21	IIIe-6	50	2c
KkD3	Kewaunee soils, 12 to 20 percent slopes, severely eroded	21	VIe-6	53	2c
KmB	Kiva sandy loam, 2 to 6 percent slopes	22	VIs-5	54	2s
KmC	Kiva sandy loam, 6 to 12 percent slopes	22	VIs-5	54	2s
KoA	Kolberg silt loam, 0 to 2 percent slopes	23	IIs-2	48	2c
KoB	Kolberg silt loam, 2 to 6 percent slopes	23	IIe-2	47	2c
KoC2	Kolberg silt loam, 6 to 12 percent slopes, eroded	24	IIIe-2	50	2c
KvB	Kolberg Variant loam, 1 to 6 percent slopes	24	IIIe-3	50	3d
KvC2	Kolberg Variant loam, 6 to 12 percent slopes, eroded	24	IVe-3	52	3d
LoA	Longrie loam, 0 to 2 percent slopes	25	IIs-1	48	2o
LoB	Longrie loam, 2 to 6 percent slopes	25	IIe-2	47	2o
LoC	Longrie loam, 6 to 12 percent slopes	26	IIIe-2	50	2o
McA	Manawa silt loam, 0 to 3 percent slopes	26	IIw-2	49	2o
MeB	Manistee loamy sand, 2 to 6 percent slopes	27	IIIs-3	50	3o
Mk	Markey muck	28	VIw-7	54	3w
NaB	Namur loam, 0 to 6 percent slopes	28	VIs-5	54	4d
NaC	Namur loam, 6 to 12 percent slopes	28	VIs-5	54	4d
Nv	Namur Variant loam	29	VIs-5	54	5w
OmB	Omena sandy loam, 2 to 6 percent slopes	30	IIe-2	47	3o
OmC	Omena sandy loam, 6 to 12 percent slopes	30	IIIe-2	50	3o
OmD	Omena sandy loam, 12 to 20 percent slopes	30	IVe-2	52	3r
OvB	Omena Variant sandy loam, 2 to 6 percent slopes	31	IIw-2	47	2o
OzB	Omro silt loam, 2 to 6 percent slopes	32	IIe-6	48	2c
Pn	Pinconning loamy fine sand	33	IIIw-6	51	4w
Po	Poygan silty clay loam	33	IIw-1	48	2w
Ra	Rock outcrop	34	VIIIs-10	54	6s

Map symbol	Mapping unit	Described on page	Capability unit		Woodland suitability subclass
			Symbol	Page	Symbol
Rb	Rock outcrop-Namur complex, 6 to 20 percent slopes	34	VIIIs-10	54	6s and 4d
Rn	Rondeau muck	34	IIIw-7	51	3w
RoB	Rousseau fine sand, 2 to 6 percent slopes	35	IIIs-3	50	3s
RoC	Rousseau fine sand, 6 to 12 percent slopes	35	IIIe-7	50	3s
RpC	Rousseau-Shawano fine sand, 2 to 12 percent slopes	35	VIs-3	53	3s and 6s
RpD	Rousseau-Shawano fine sands, 12 to 35 percent slopes	36	VIIs-3	54	3s and 6s
RrB	Rousseau-Deford fine sands, 2 to 6 percent slopes	36	IVw-5	52	3s and 4w
Sa	Saprists	36	VIIIw-15	54	6w
SnA	Sisson fine sandy loam, 0 to 2 percent slopes	38	I-4	47	1o
SnB	Sisson fine sandy loam, 2 to 8 percent slopes	38	IIe-1	47	1o
SoA	Solona loam, 0 to 3 percent slopes	39	IIw-2	49	2o
Su	Suamico muck	40	IVw-7	52	3w
SvA	Summerville loam, 0 to 2 percent slopes	41	IIIs-8	51	3d
SvB	Summerville loam, 2 to 6 percent slopes	41	IIIe-3	50	3d
SvC	Summerville loam, 6 to 12 percent slopes	41	IVe-3	52	3d
SvD	Summerville loam, 12 to 20 percent slopes	41	VIe-3	53	3d
Ud	Udipsamments	42	VIIs-9	54	6s
Uo	Udorthents, cobbly	42	VIIs-9	54	6s
Wa	Wainola loamy fine sand	43	IVw-5	52	3o
YaA	Yahara fine sandy loam, 0 to 3 percent slopes	43	IIw-4	50	1o
Yv	Yahara Variant silt loam	44	IIIw-3	51	1o

1/ NG means not grouped.

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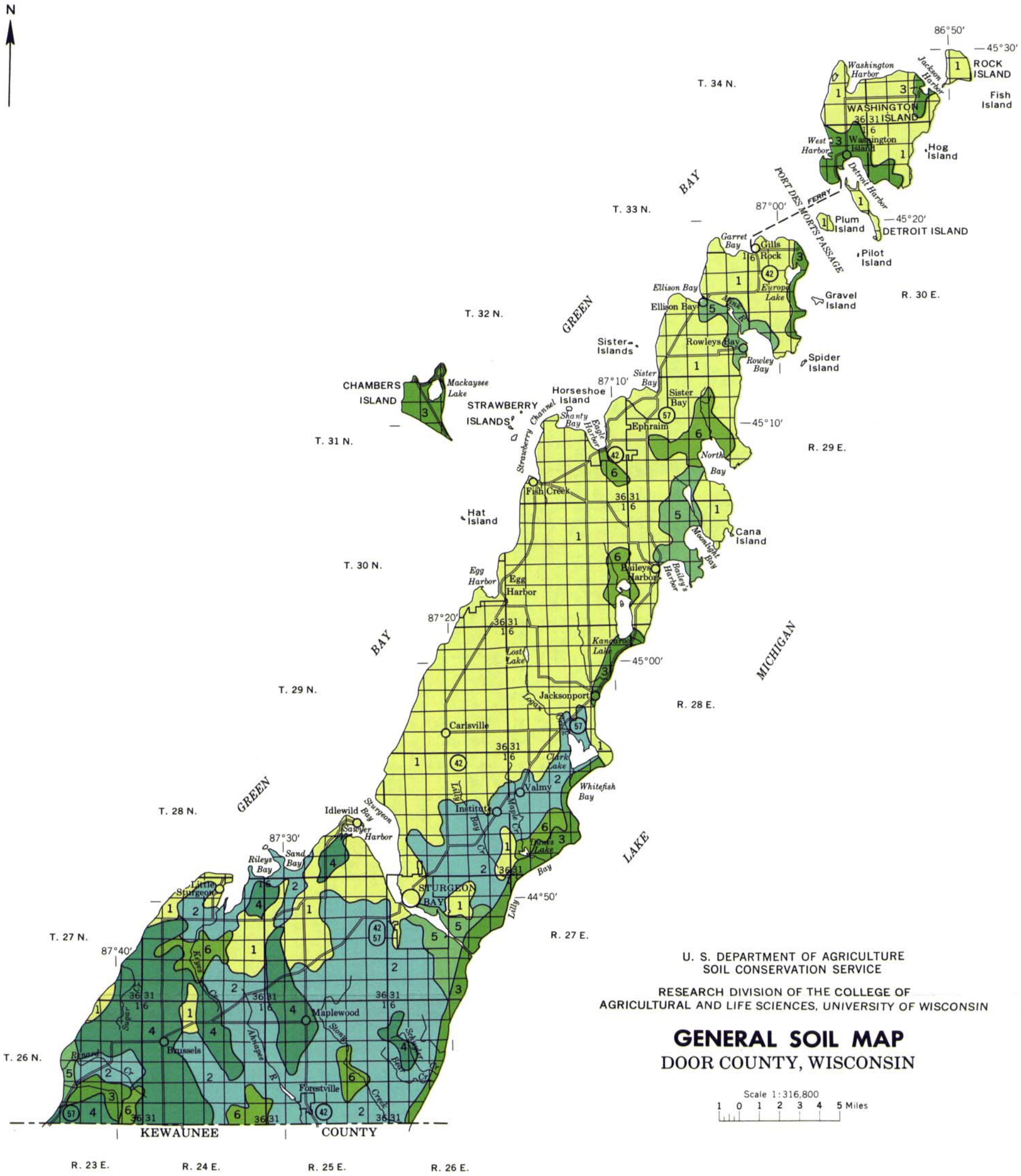


U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

RESEARCH DIVISION OF THE COLLEGE OF
AGRICULTURAL AND LIFE SCIENCES, UNIVERSITY OF WISCONSIN

GENERAL SOIL MAP
DOOR COUNTY, WISCONSIN

Scale 1:316,800
1 0 1 2 3 4 5 Miles

SOIL LEGEND

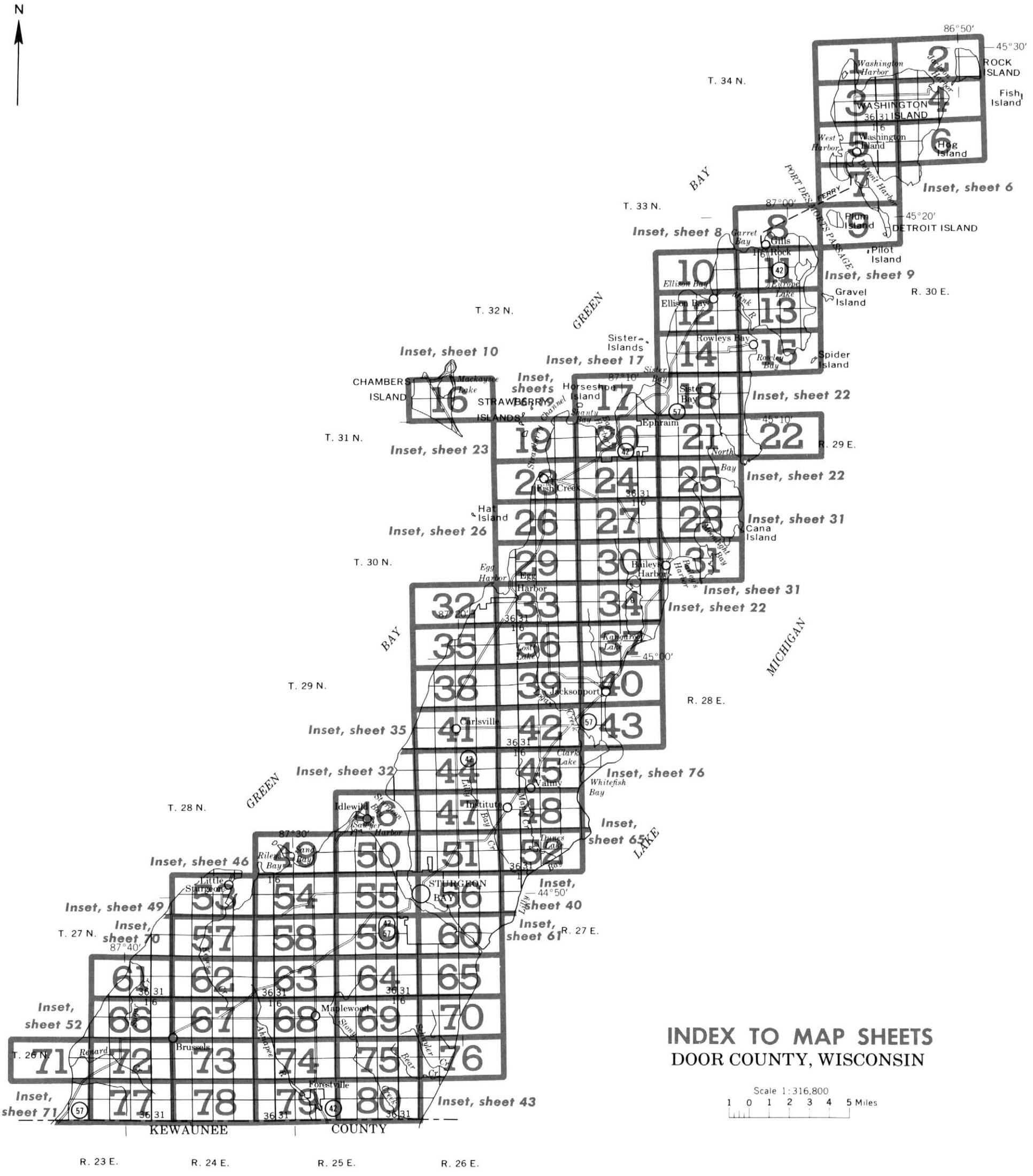
1. Summerville-Longrie-Omena association: Shallow to deep, well drained, nearly level to moderately steep soils that have a sandy loam or loam subsoil over sandy loam or fine sandy loam till or dolomite bedrock
2. Emmet-Solona-Angelica association: Deep, well drained to poorly drained, nearly level to sloping soils that have a loamy sand to silt loam subsoil over sandy loam or loam till
3. Rousseau-Kiva-Markey association: Deep, well drained and moderately well drained, gently sloping and sloping soils that have a fine sand or sandy loam subsoil over sand or sand and gravel outwash, and very poorly drained, nearly level organic soils
4. Kewaunee-Kolberg-Manawa association: Deep and moderately deep, well drained and somewhat poorly drained, nearly level to moderately steep soils that have a dominantly silty clay subsoil over silty clay till or dolomite bedrock
5. Deford-Yahara Variant-Carbondale association: Deep, poorly drained, nearly level soils that are underlain by fine sand outwash or that have a silt loam subsoil over stratified lake sediments, and very poorly drained, nearly level organic soils
6. Carbondale-Cathro association: Very poorly drained, nearly level organic soils

Compiled 1977

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36



INDEX TO MAP SHEETS
DOOR COUNTY, WISCONSIN

Scale 1:316,800

1 0 1 2 3 4 5 Miles

Original text from each individual map sheet read:

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

SOIL LEGEND

The first capital letter is the initial one of the soil name. The lower case letter that follows separates mapping units having names that begin with the same letter except that it does not separate sloping or eroded phases. The second capital letter indicates the class of slope. Symbols without a slope letter are for soils with a slope range of 0 to 2 percent or they are for miscellaneous areas with a considerable range of slope. A final number of 2 or 3 in the symbol indicates that the soil is eroded or severely eroded respectively.

SYMBOL	NAME
AdA	Allendale loamy sand, 0 to 3 percent slopes
ApC	Alpena gravelly sandy loam, 0 to 12 percent slopes
Ax	Angelica loam
Be	Beaches
Bn	Bonduel loam
Bo	Bonduel Shallow Variant fine sandy loam
Bp	Bonduel Wet Variant loam
BrB	Boyer loamy sand, 2 to 6 percent slopes
BrC	Boyer loamy sand, 6 to 12 percent slopes
BrD	Boyer loamy sand, 12 to 20 percent slopes
Ca	Carbondale muck
CcB	Casco sandy loam, 2 to 6 percent slopes
CcC2	Casco sandy loam, 6 to 12 percent slopes, eroded
Cm	Cathro muck
Cp	Chippeny muck
De	Deford loamy fine sand
DuB	Duel loamy sand, 1 to 6 percent slopes
Dv	Duel Variant sandy loam
EmA	Emmet sandy loam, 0 to 2 percent slopes
EmB	Emmet sandy loam, 2 to 6 percent slopes
EmC2	Emmet sandy loam, 6 to 12 percent slopes, eroded
EmD2	Emmet sandy loam, 12 to 20 percent slopes, eroded
EmE	Emmet sandy loam, 20 to 35 percent slopes
Fa	Fabius silt loam
Fu	Fluvaquents
Gp	Gravel pits
KhA	Kewaunee silt loam, 0 to 2 percent slopes
KhB	Kewaunee silt loam, 2 to 6 percent slopes
KhC2	Kewaunee silt loam, 6 to 12 percent slopes, eroded
KkD3	Kewaunee soils, 12 to 20 percent slopes, severely eroded
KmB	Kiva sandy loam, 2 to 6 percent slopes
KmC	Kiva sandy loam, 6 to 12 percent slopes
KoA	Kolberg silt loam, 0 to 2 percent slopes
KoB	Kolberg silt loam, 2 to 6 percent slopes
KoC2	Kolberg silt loam, 6 to 12 percent slopes, eroded
KvB	Kolberg Variant loam, 1 to 6 percent slopes
KvC2	Kolberg Variant loam, 6 to 12 percent slopes, eroded
LoA	Longrie loam, 0 to 2 percent slopes
LoB	Longrie loam, 2 to 6 percent slopes
LoC	Longrie loam, 6 to 12 percent slopes
McA	Manawa silt loam, 0 to 3 percent slopes
MeB	Manistee loamy sand, 2 to 6 percent slopes
Mk	Markey muck
NaB	Namur loam, 0 to 6 percent slopes
NaC	Namur loam, 6 to 12 percent slopes
Nv	Namur Variant loam
OmB	Omena sandy loam, 2 to 6 percent slopes
OmC	Omena sandy loam, 6 to 12 percent slopes
OmD	Omena sandy loam, 12 to 20 percent slopes
OvB	Omena Variant sandy loam, 2 to 6 percent slopes
OzB	Omro silt loam, 2 to 6 percent slopes
Pn	Pinconning loamy fine sand
Po	Poygan silty clay loam
Ra	Rock outcrop
Rb	Rock outcrop-Namur complex, 6 to 20 percent slopes
Rn	Rondeau muck
RoB	Rousseau fine sand, 2 to 6 percent slopes
RoC	Rousseau fine sand, 6 to 12 percent slopes
RpC	Rousseau-Shawano fine sands, 2 to 12 percent slopes
RpD	Rousseau-Shawano fine sands, 12 to 35 percent slopes
RrB	Rousseau-Deford fine sands, 2 to 6 percent slopes
Sa	Saprists
SnA	Sisson fine sandy loam, 0 to 2 percent slopes
SnB	Sisson fine sandy loam, 2 to 8 percent slopes
SoA	Solona loam, 0 to 3 percent slopes
Su	Suamico muck
SvA	Summerville loam, 0 to 2 percent slopes
SvB	Summerville loam, 2 to 6 percent slopes
SvC	Summerville loam, 6 to 12 percent slopes
SvD	Summerville loam, 12 to 20 percent slopes
Ud	Udipsamments
Uo	Udorthents, cobbly
Wa	Wainola loamy fine sand
YaA	Yahara fine sandy loam, 0 to 3 percent slopes
Yv	Yahara Variant silt loam

DOOR COUNTY, WISCONSIN

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

National, state or province

County or parish

Minor civil division

Reservation (national forest or park, state forest or park, and large airport)

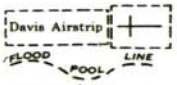
Land grant

Limit of soil survey (label)

Field sheet matchline & neatline

AD HOC BOUNDARY (label)

Small airport, airfield, park, oilfield, cemetery, or flood pool



STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

Divided (median shown if scale permits)

Other roads

Trail

ROAD EMBLEMS & DESIGNATIONS

Interstate

Federal

State

County, farm or ranch

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

Without road

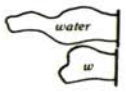
With road

With railroad

DAMS

Large (to scale)

Medium or small



PITS

Gravel pit

Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

Farmstead, house (omit in urban areas)

Church

School

Indian mound (label)

Located object (label)

Tank (label)

Wells, oil or gas

Windmill

Kitchen midden

WATER FEATURES

DRAINAGE

Perennial, double line

Perennial, single line

Intermittent

Drainage end

Canals or ditches

Double-line (label)

Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

Perennial

Intermittent

MISCELLANEOUS WATER FEATURES

Marsh or swamp

Spring

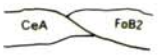
Well, artesian

Well, irrigation

Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS



ESCARPMENTS

Bedrock (points down slope)

Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

SOIL SAMPLE SITE (normally not shown)

MISCELLANEOUS

Blowout

Clay spot

Gravelly spot

Gumbo, slick or scabby spot (sodic)

Dumps and other similar non soil areas

Prominent hill or peak

Rock outcrop (includes sandstone and shale)

Saline spot

Sandy spot

Severely eroded spot

Slide or slip (tips point upslope)

Stony spot, very stony spot

Shale spot

Cut and fill land

DOOR COUNTY, WISCONSIN — SHEET NUMBER 1

2 780 000 FEET

R. 29 E. | R. 30 E.

595 000 FEET

T. 34 N.

GREEN BAY

Boyer Bluff

WASHINGTON ISLAND

Little Lake

Washington Harbor

24

19

NaC

Uo

2 795 000 FEET

590 000 FEET

(Joins sheet 2)

(Joins sheet 3)

N

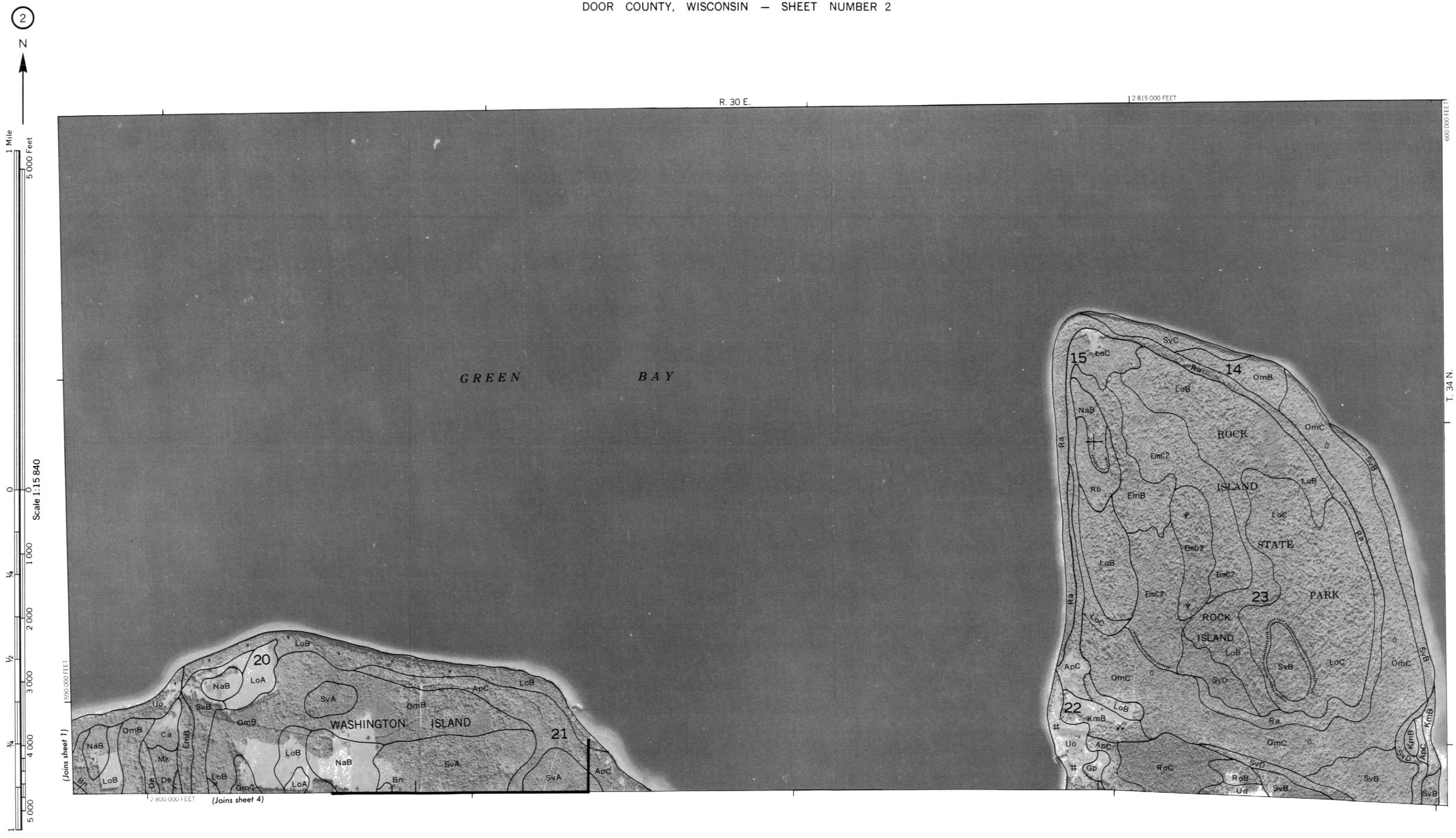
1 Mile

5 000 Feet

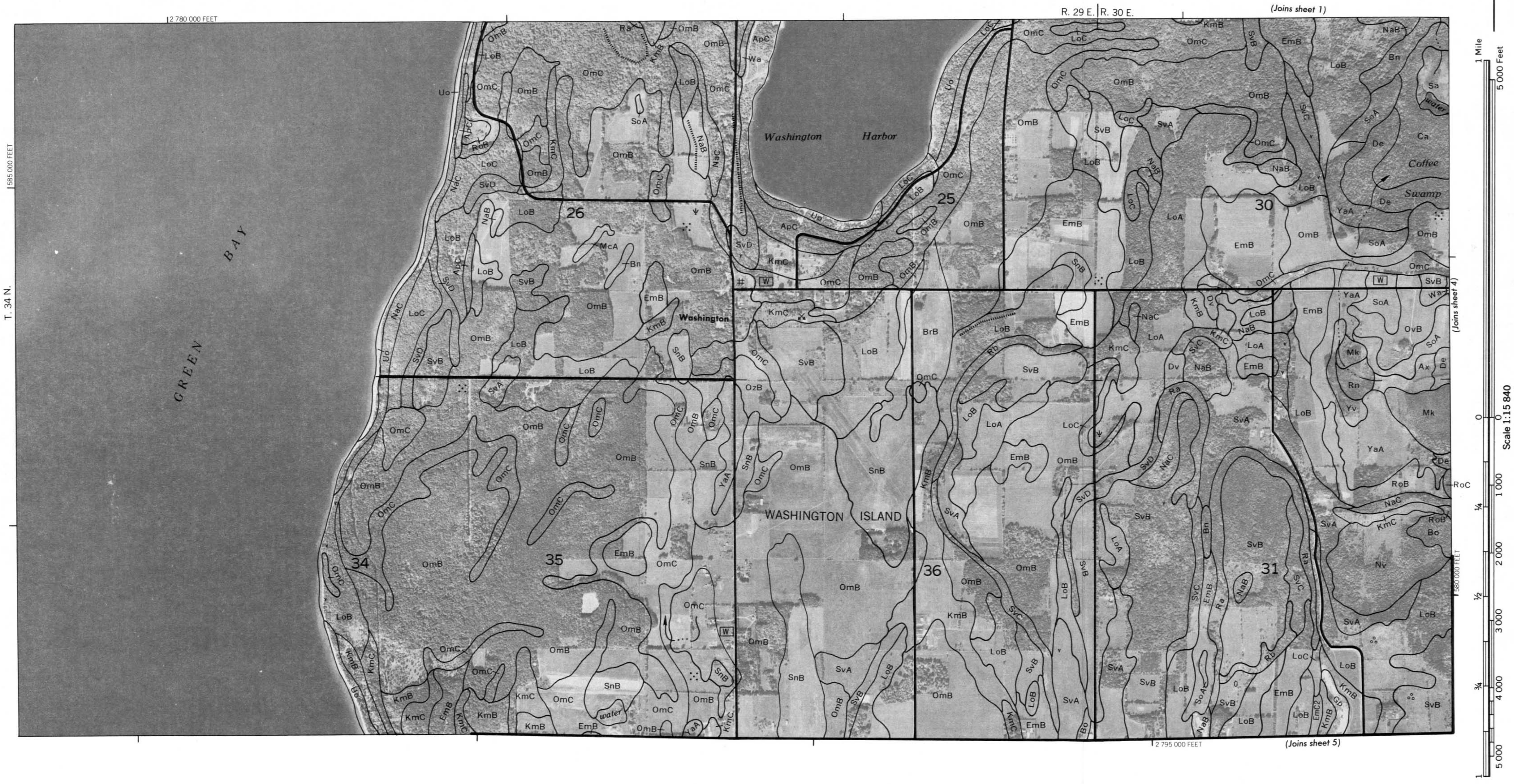
Scale 1:15 840

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

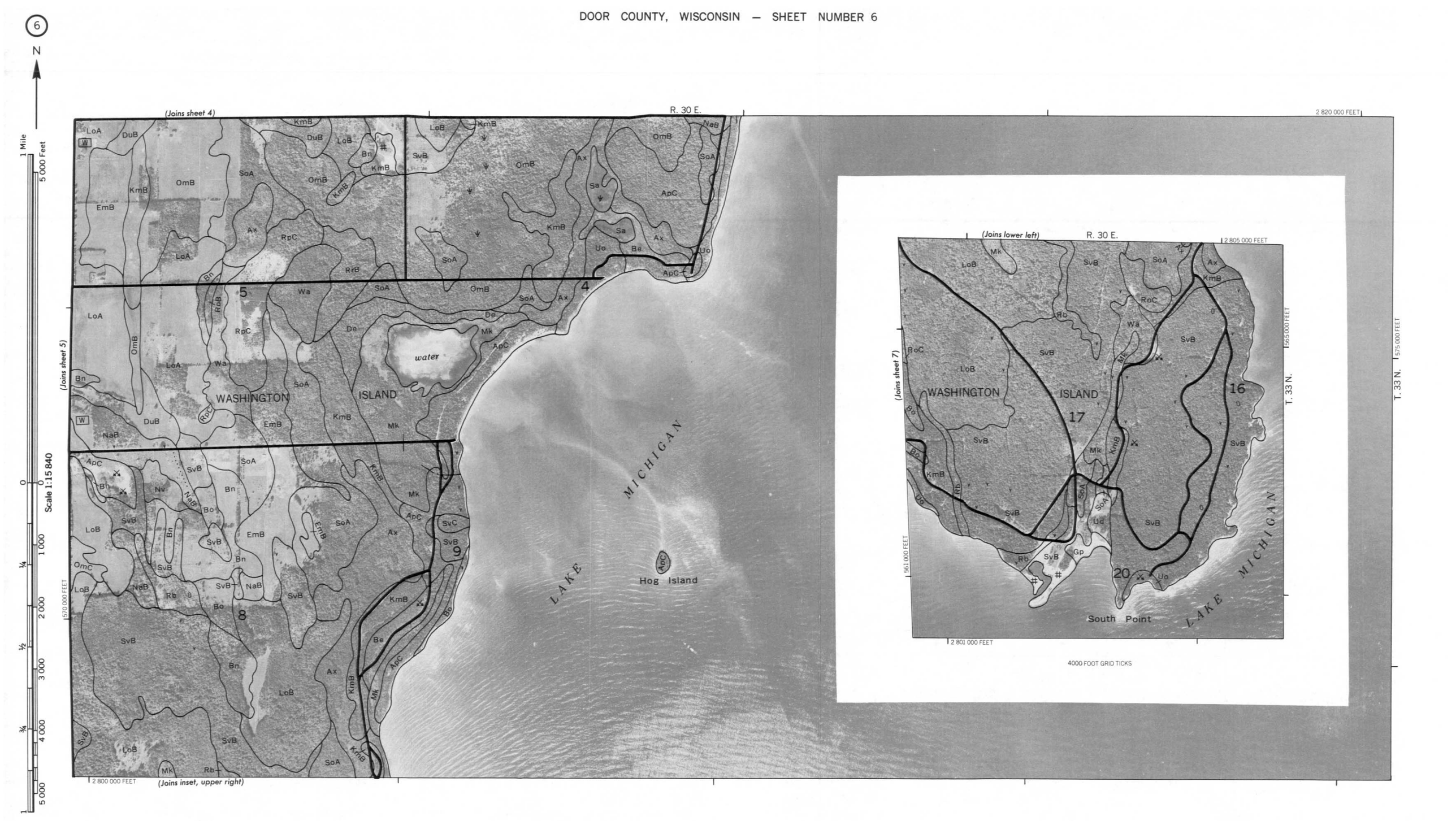

2
N
1 Mile
5 000 Feet
Scale 1:15 840
R. 30 E.
2 815 000 FEET
600 000 FEET
T. 34 N.
GREEN BAY
WASHINGTON ISLAND
ROCK ISLAND STATE PARK
20
21
22
23
15
14
590 000 FEET
2 800 000 FEET
(Joins sheet 1)
(Joins sheet 4)
LoB
NaB
LoA
SvA
SvB
OmB
ApC
Uo
Ca
EmB
Mk
De
Bn
OmC
SvC
Ra
Rb
EmC2
EmD2
LoC
KmB
RoC
RoB
Ud
Gp
SvD
KmC

3


N
(Joins sheet 1)
(Joins sheet 4)
(Joins sheet 5)
R. 29 E.
R. 30 E.
T. 34 N.
2 780 000 FEET
2 795 000 FEET
585 000 FEET
580 000 FEET
GREEN BAY
Washington Harbor
Washington
WASHINGTON ISLAND
Coffee Swamp
25
26
30
31
34
35
36
Scale 1:15 840
1 Mile
5 000 Feet
0
1/4
1/2
3/4
1
1000
2000
3000
4000
5000


4
N
(Joins sheet 2)
(Joins sheet 3)
(Joins sheet 6)
R. 30 E.
T. 34 N.
2 820 000 FEET
2 800 000 FEET
585 000 FEET
580 000 FEET
Coffee Swamp
Jackson Harbor
WASHINGTON ISLAND
ROCK ISLAND
ROCK ISLAND STATE PARK
LAKE MICHIGAN
26
27
28
29
32
33
34
Scale 1:15 840
1 Mile
5 000 Feet
0
1/4
1/2
3/4
1
1 000
2 000
3 000
4 000
5 000


5
N
(Joins sheet 3)
(Joins sheet 6)
(Joins sheet 7)
R. 29 E.
R. 30 E.
T. 33 N.
2 780 000 FEET
2 795 000 FEET
575 000 FEET
570 000 FEET
GREEN BAY
WASHINGTON ISLAND
Detroit Harbor
West Harbor
Trinity Church
Scale 1:15 840
1 Mile
5 000 Feet
1 Kilometer


6
N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 4)
(Joins sheet 5)
(Joins inset, upper right)
R. 30 E.
2 820 000 FEET
2 800 000 FEET
570 000 FEET
T. 33 N.
575 000 FEET
WASHINGTON ISLAND
water
MICHIGAN
LAKE
Hog Island
(Joins lower left)
(Joins sheet 7)
2 805 000 FEET
565 000 FEET
561 000 FEET
2 801 000 FEET
South Point
4000 FOOT GRID TICKS

7

N

2 780 000 FEET

565 000 FEET

T. 33 N.

R. 29 E. | R. 30 E.

(Joins sheet 5)

(Joins inset, sheet 6)

WASHINGTON ISLAND

Lobdells Point

Detroit Harbor

GREEN BAY

LAKE MICHIGAN

DETROIT ISLAND

560 000 FEET

2 800 000 FEET

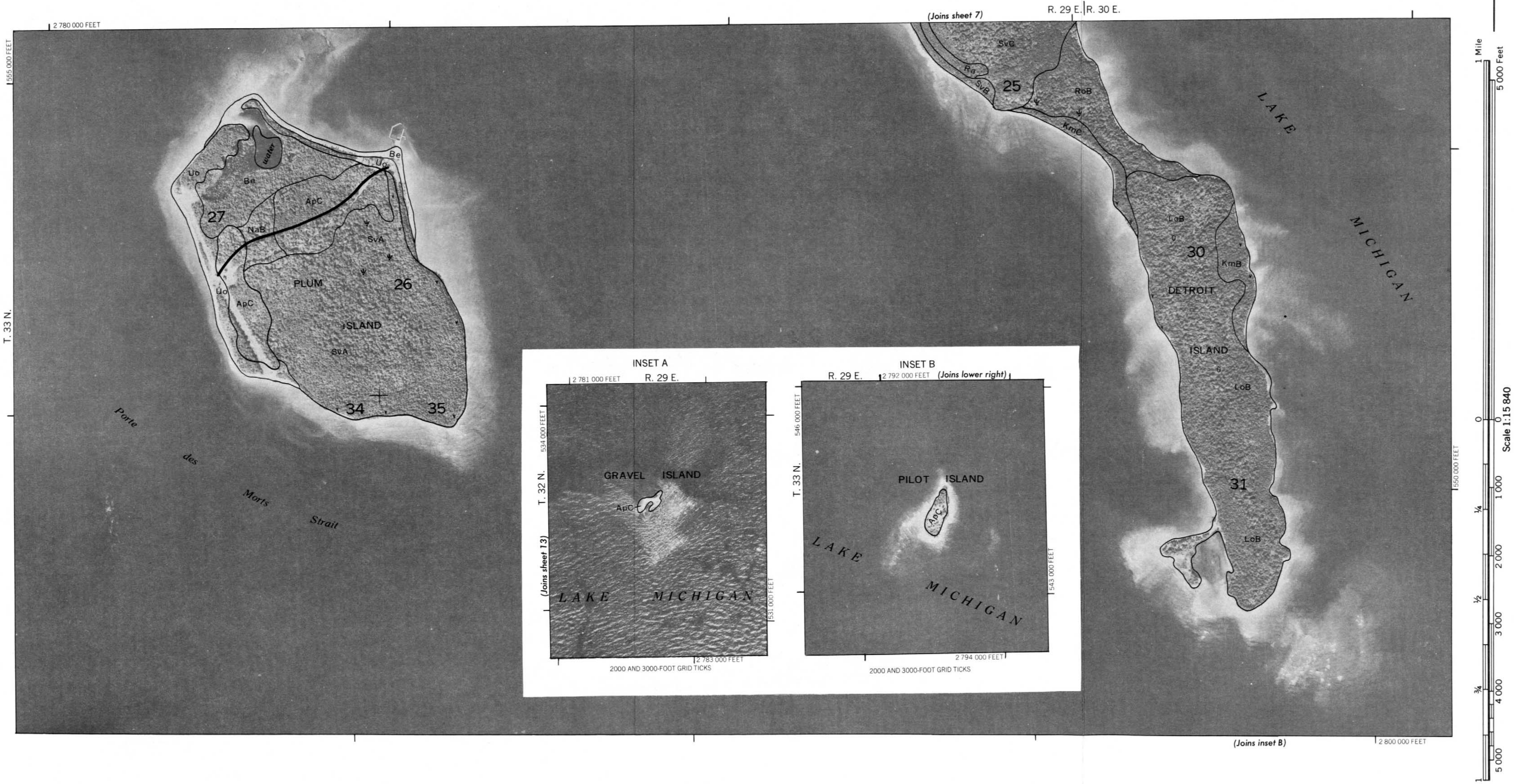
(Joins sheet 9)

1 Mile

5 000 Feet

Scale 1:15 840


N
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
¼
2 000
½
3 000
¾
4 000
5 000
R. 29 E.
2 775 000 FEET
555 000 FEET
T. 33 N.
(Joins inset)
GREEN BAY
R. 28 E.
2 758 000 FEET
548 000 FEET
545 000 FEET
T. 33 N.
Deathdoor Bluff
GREEN
BAY
(Joins lower left)
35
SvB
LoC
LoB
SvA
EmC2
OmC
NaC
ApC
Ra
SvD
SvC
2 755 000 FEET
(Joins sheet 10)
3000 AND 3000-FOOT GRID TICKS
Table Bluff
Wisconsin Bay
31
32
33
LoB
ApC
RoB
EmB
OmC
OmB
NaB
NaC
SvC
Uo
LoA
Gp
KmB
SvB
EmC2
SvA
Ra
Gills Rock
KoA
YaA
Yv
42
Northport
RaC
Hedgehog Harbor
545 000 FEET
2 760 000 FEET
SvD
(Joins sheet 11)


N
(Joins sheet 7)
R. 29 E. R. 30 E.
2 780 000 FEET
555 000 FEET
T. 33 N.
PLUM
ISLAND
DETROIT
ISLAND
LAKE
MICHIGAN
Porte des Morts Strait
Uo
Be
water
ApC
NaB
SvA
27
26
34
35
SvC
Ra
SvB
25
RoB
KmC
LoB
30
KmB
31
550 000 FEET
(Joins inset B)
2 800 000 FEET
INSET A
R. 29 E.
2 781 000 FEET
534 000 FEET
T. 32 N.
GRAVEL ISLAND
ApC
(Joins sheet 13)
LAKE MICHIGAN
531 000 FEET
2 783 000 FEET
2000 AND 3000-FOOT GRID TICKS
INSET B
R. 29 E.
2 792 000 FEET
(Joins lower right)
546 000 FEET
T. 33 N.
PILOT ISLAND
ApC
LAKE MICHIGAN
543 000 FEET
2 794 000 FEET
2000 AND 3000-FOOT GRID TICKS
1 Mile
5 000 Feet
Scale 1:15 840
0
¼
½
¾
1
1000
2000
3000
4000
5 000

10

N

1 Mile

5 000 Feet

Scale 1:15 840

0 0

¼ 1 000

½ 2 000

¾ 3 000

1 4 000

5 000

R. 28 E.

R. 26 E.

2 685 000 FEET

2 755 000 FEET

(Joins inset, sheet 8)

510 000 FEET

513 000 FEET

535 000 FEET

540 000 FEET

T. 32 N.

GREEN BAY

33

34

32

2

3

10

11

CHAMBERS ISLAND

KmB

RoB

BrB

CcB

Ud

Sa

RoC

Wa

Ra

LoB

EmC2

OmC

SvB

ApC

OmB

SvC

LoC

NaC

NaB

SvA

LoA

Ax

SnB

EmB

SoA

YaA

Yv

Rn

Ψ

water

(Joins sheet 16)

2 680 000 FEET

3000 AND 5000-FOOT GRID TICKS

2 740 000 FEET

(Joins sheet 11)

(Joins sheet 12)

DOOR COUNTY, WISCONSIN — SHEET NUMBER 11

11

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

DOOR COUNTY, WISCONSIN — **SHEET** NUMBER 12

12

N

1 Mile

5 000 Feet

Scale 1:15 840

0 0

¼ 1 000

½ 2 000

¾ 3 000

1 4 000

5 000

525 300 FEET

R. 28 E.

Ellison Bluff

Ellison Bay

BAY

GREEN

Ellison Bay

LIBERTY GROVE CEMETERY

16 15 14

20 21 22 23

2 755 000 FEET

(Joins sheet 10)

2 740 000 FEET

(Joins sheet 14)

530 000 FEET

T. 32 N.

(Joins sheet 13)

13

N

1 Mile

5 000 Feet

Scale 1:15 840

14

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

R. 28 E.

2 755 000 FEET

520 000 FEET

515 000 FEET

2 740 000 FEET

T. 32 N.

(Joins sheet 12)

(Joins inset, sheet 17)

(Joins sheet 18)

(Joins sheet 13)

BAY

GREEN

29 28 27 26 32 33 34 35


15
N
R. 28 E.
R. 29 E.
2 760 000 FEET
(Joins sheet 13)
520 000 FEET
T. 32 N.
(Joins sheet 14)
(Joins inset, sheet 22)
2 780 000 FEET
515 000 FEET
Rowley
Bay
Rowleys Bay
NEWPORT
STATE
PARK
SPIDER
ISLAND
LAKE
MICHIGAN
25
30
29
28
32
33
36
1 Mile
5 000 Feet
Scale 1:15 840
0
¼
½
¾
1
0
1000
2000
3000
4000
5 000

16

N

1 Mile

5 000 Feet

Scale 1:15 840

(Joins inset, sheet 10)

R. 26 E.

2 695 000 FEET

510 000 FEET

T. 31 N.

Sand Point

Green Bay

MacKaysee Lake

Mud Lake

CHAMBERS ISLAND

GREEN BAY

Be Ud KmB De RrB RoB CcB CcC2 Wa Mk ApC RoC Fa BrB BrC BrD Sa

3 4 5 8 9 10

500 000 FEET

2 680 000 FEET

(Joins inset, sheet 23)

R. 27 E.

2 706 000 FEET

502 000 FEET

499 000 FEET

2 703 000 FEET

Jack Island

17

(Joins sheet 19)

3000 AND 3000-FOOT GRID TICKS


N
2 720 000 FEET
R. 27 E.
R. 28 E.
510 000 FEET
T. 31 N.
T. 32 N.
521 000 FEET
518 000 FEET
505 000 FEET
2 735 000 FEET
GREEN BAY
Bluffs
Sister
LITTLE SISTER CEMETERY
HORSESHOE ISLAND
10
6
7
12
42
(Joins sheet 18)
(Joins sheet 20)
2 733 000 FEET
2 737 000 FEET
SISTER ISLANDS
(Joins sheet 14)
3000 AND 4000-FOOT GRID TICKS
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

(Joins sheet 14)

R. 28 E.

2 760 000 FEET

510 000 FEET

T. 31 N.

(Joins sheet 17)

(Joins inset, sheet 22)

505 000 FEET

2 740 000 FEET

(Joins sheet 21)

Bay

Sister

Sister Bay

water

5 4 3 2 1

8 9 10 11 12

N

1 Mile 5 000 Feet

Scale 1:15 840

0 0 ¼ 1 000 ½ 2 000 ¾ 4 000 1 5 000

2 700 000 FEET

1 495 000 FEET

T. 31 N.

R. 27 E.

(Joins inset, sheet 16) | (Joins inset)

Little Strawberry Island

Adventure Island

STRAWBERRY CHANNEL

Tennison Bay

Shanty Bay

PENINSULA STATE PARK

(Joins sheet 20)

2 715 000 FEET

(Joins sheet 23)

2 711 000 FEET

501 000 FEET

500 000 FEET

2 716 000 FEET

GREEN BAY

Eagle Bluff

(Joins upper right)

1000 AND 5000-FOOT GRID TICKS

DOOR COUNTY, WISCONSIN — SHEET NUMBER 20


21
N
2 740 000 FEET
R. 28 E.
(Joins sheet 18)
500 000 FEET
T. 31 N.
(Joins sheet 20)
(Joins sheet 22)
(Joins sheet 25)
495 000 FEET
2 760 000 FEET
North Bay
North Bay
1 Mile
5 000 Feet
Scale 1:15 840
0
1000
2000
3000
4000
5000
¼
½
¾
1

22

N

1 Mile

5 000 Feet

Scale 1:15 840

0 0

¼ 1 000

½ 2 000

¾ 3 000

1 4 000

1¼ 5 000

(Joins inset, lower right)

R. 28 E.

2 770 000 FEET

500 000 FEET

490 000 FEET

T. 31 N.

T. 30 N.

495 000 FEET

488 000 FEET

2 762 000 FEET

2 765 000 FEET

(Joins inset A)

(Joins lower left)

(Joins sheet 25)

(Joins sheet 21)

13

25

24

LAKE MICHIGAN

2000 AND 4000-FOOT GRID TICKS

INSET A

(Joins sheet 31)

2 743 000 FEET

455 000 FEET

(Joins sheet 34)

29

32

Boynton Chapel

450 000 FEET

2 742 000 FEET

1000 AND 5000-FOOT GRID TICKS

INSET B

(Joins sheet 15)

2 765 000 FEET

510 000 FEET

505 000 FEET

(Joins sheet 18)

1

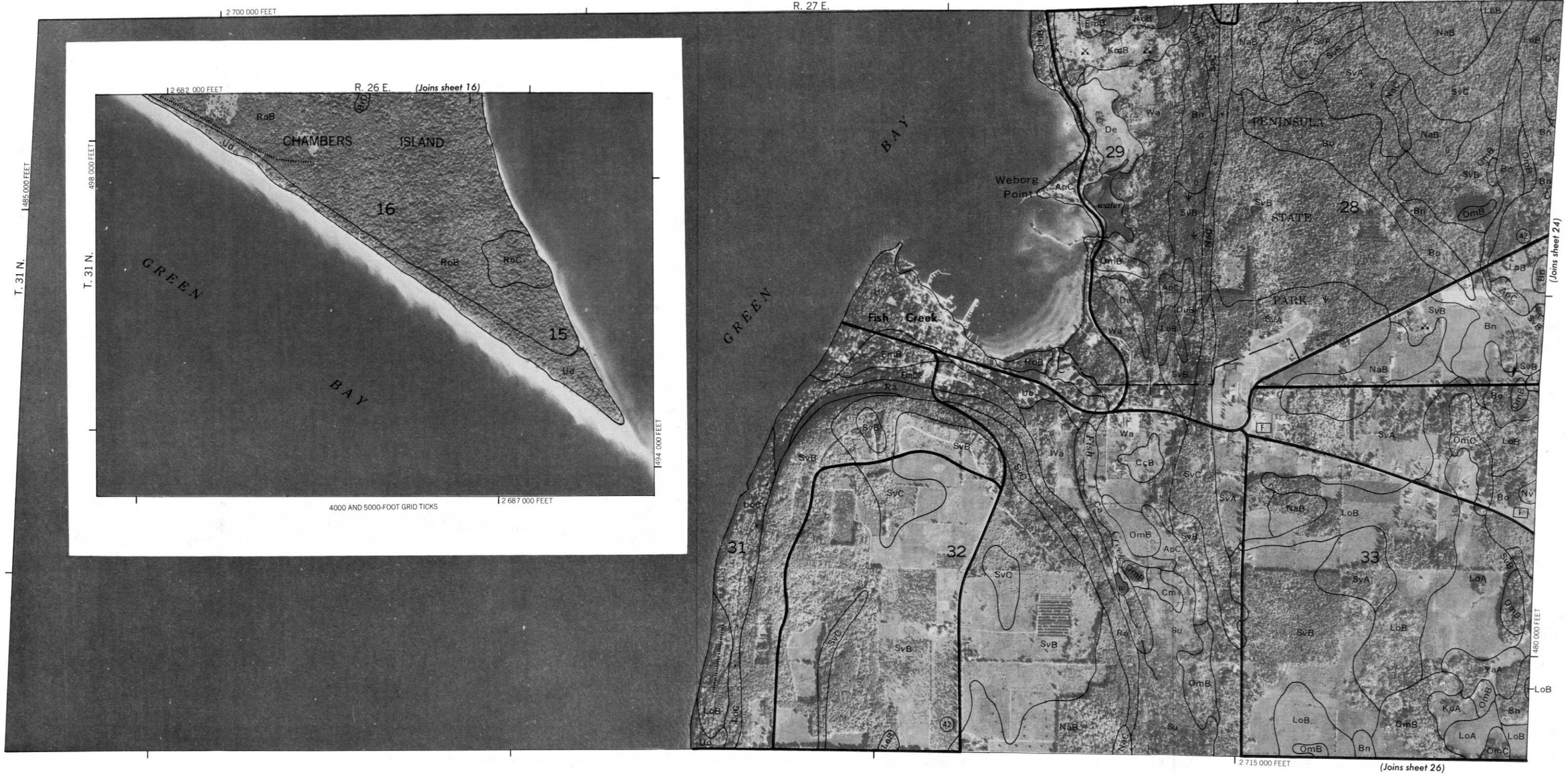
12

2 761 000 FEET

(Joins upper left)

4000 AND 5000-FOOT GRID TICKS

INSET C



23

N

1 Mile

5 000 Feet

Scale 1:15 840

0 1/4 1/2 3/4 1

0 1 000 2 000 3 000 4 000 5 000

24

N

1 Mile

5 000 Feet

Scale 1:15 840

0 0

¼ 1 000

½ 2 000

¾ 3 000

1 4 000

5 000

R. 27 E. | R. 28 E.

2 735 000 FEET

490 000 FEET

480 000 FEET

2 720 000 FEET

T. 31 N.

(Joins sheet 20)

(Joins sheet 23)

(Joins sheet 25)

(Joins sheet 27)

PENINSULA STATE PARK

EPHRAIM FISH CREEK AIRPORT

Ephraim Swamp

27 26 25 30 34 35 36 31

DOOR COUNTY, WISCONSIN — SHEET NUMBER 25

25

N

2 740 000 FEET

490 000 FEET

(Joins sheet 21)

R. 28 E.

T. 31 N.

(Joins sheet 24)

(Joins inset, sheet 22)

485 000 FEET

(Joins sheet 28)

2 760 000 FEET

North Bay

Mud Lake

1 Mile

5 000 Feet

Scale 1:15 840


26
N
1 Mile
5 000 Feet
Scale 1:15 840
R. 26 E.
2 694 000 FEET
Hat Island
ApC
GREEN BAY
473 000 FEET
475 000 FEET
T. 30 N.
2 692 000 FEET
2000 AND 2000-FOOT GRID TICKS
(Joins upper left)
(Joins inset)
R. 27 E.
2 715 000 FEET
(Joins sheet 23)
Button Marsh
GREEN BAY
470 000 FEET
2 700 000 FEET
T. 30 N.
475 000 FEET
(Joins sheet 27)
(Joins sheet 29)

DOOR COUNTY, WISCONSIN — SHEET NUMBER 27

27

N

R. 27 E. | R. 28 E.

(Joins sheet 24)

2 720 000 FEET

2 740 000 FEET

475 000 FEET

470 000 FEET

T. 30 N.

(Joins sheet 26)

(Joins sheet 28)

(Joins sheet 30)

Bailey's Harbor Swamp

Zion Church

QUARRY

1 Mile

5 000 Feet

Scale 1:15 840

0 0

¼ 1 000

½ 2 000

¾ 3 000

1 4 000

5 000

28

N

1 Mile

5 000 Feet

Scale 1:15 840

(Joins sheet 25)

R. 28 E.

2 760 000 FEET

480 000 FEET

T. 30 N.

(Joins sheet 27)

(Joins inset B, sheet 31)

470 000 FEET

Cm

Rb

(Joins sheet 31)

2 745 000 FEET

Mud Lake

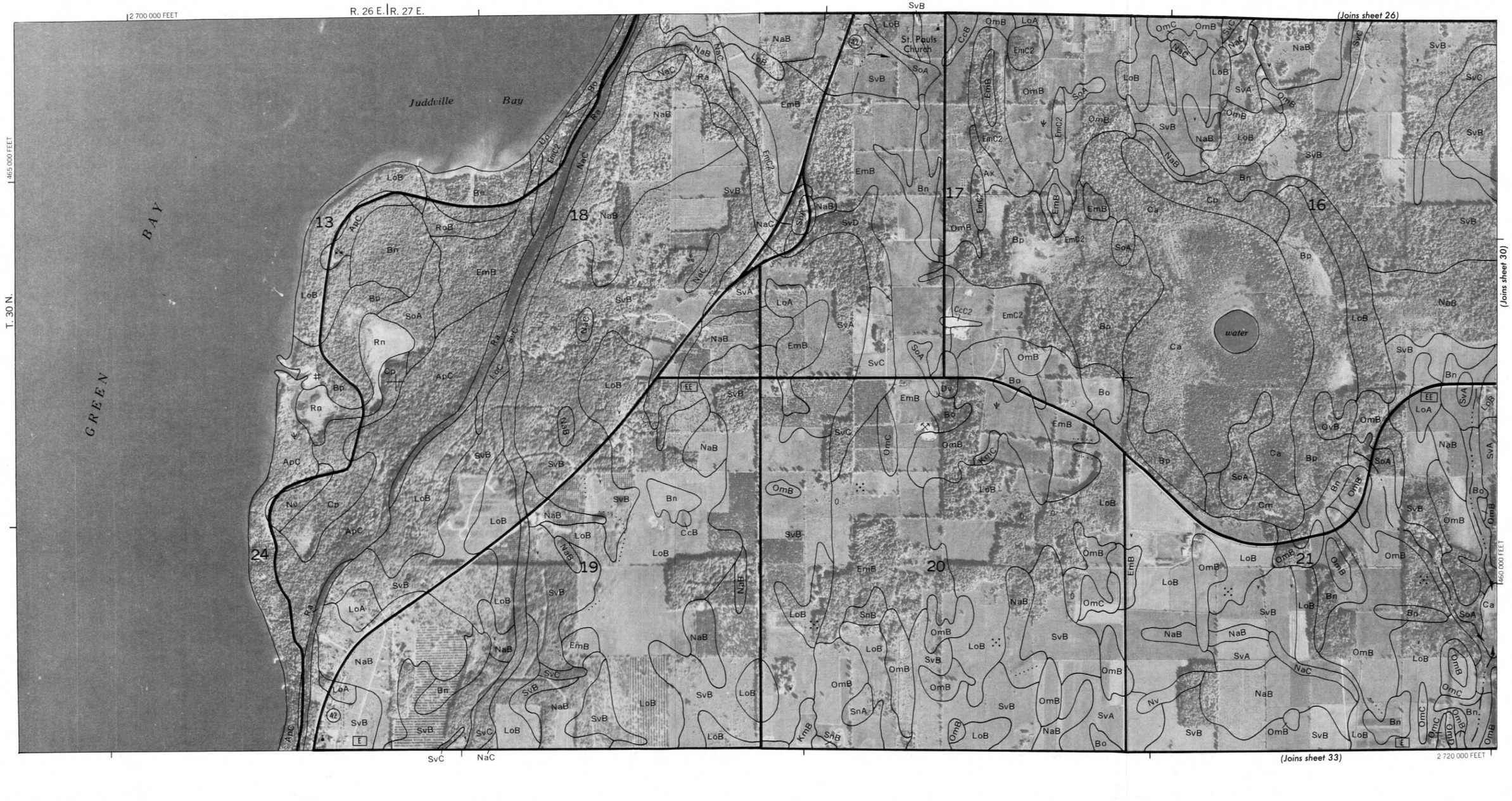
Moonlight Bay

water

LAKE MICHIGAN

LAKE MICHIGAN

Mk Ca De SoA EmB Ax Yv Cm EmB Wa RoB OmB SoA Cm Bp Gp KmB OmC ApC NaB LoB SvB SvC YaA Bn NaC RrB Be DuB Dv RoC Cp Bo Uo Fa Ya Nv


2 700 000 FEET
R. 26 E.
R. 27 E.
465 000 FEET
T. 30 N.
Juddville Bay
GREEN BAY
St. Pauls Church
water
(Joins sheet 26)
(Joins sheet 30)
(Joins sheet 33)
2 720 000 FEET
460 000 FEET
13
18
17
16
24
19
20
21
N
1 Mile
5 000 Feet
Scale 1:15 840
0
1/4
1/2
3/4
1
1 000
2 000
3 000
4 000
5 000

DOOR COUNTY, WISCONSIN — SHEET NUMBER 30

30

N

1 Mile

5 000 Feet

Scale 1:15 840

0 0 ¼ 1 000 ½ 2 000 ¾ 4 000 1 5 000

(Joins sheet 27)

(Joins sheet 29)

(Joins sheet 34)

(Joins sheet 31)

R. 27 E. | R. 28 E.

T. 30 N.

2 740 000 FEET

2 725 000 FEET

460 000 FEET

465 000 FEET

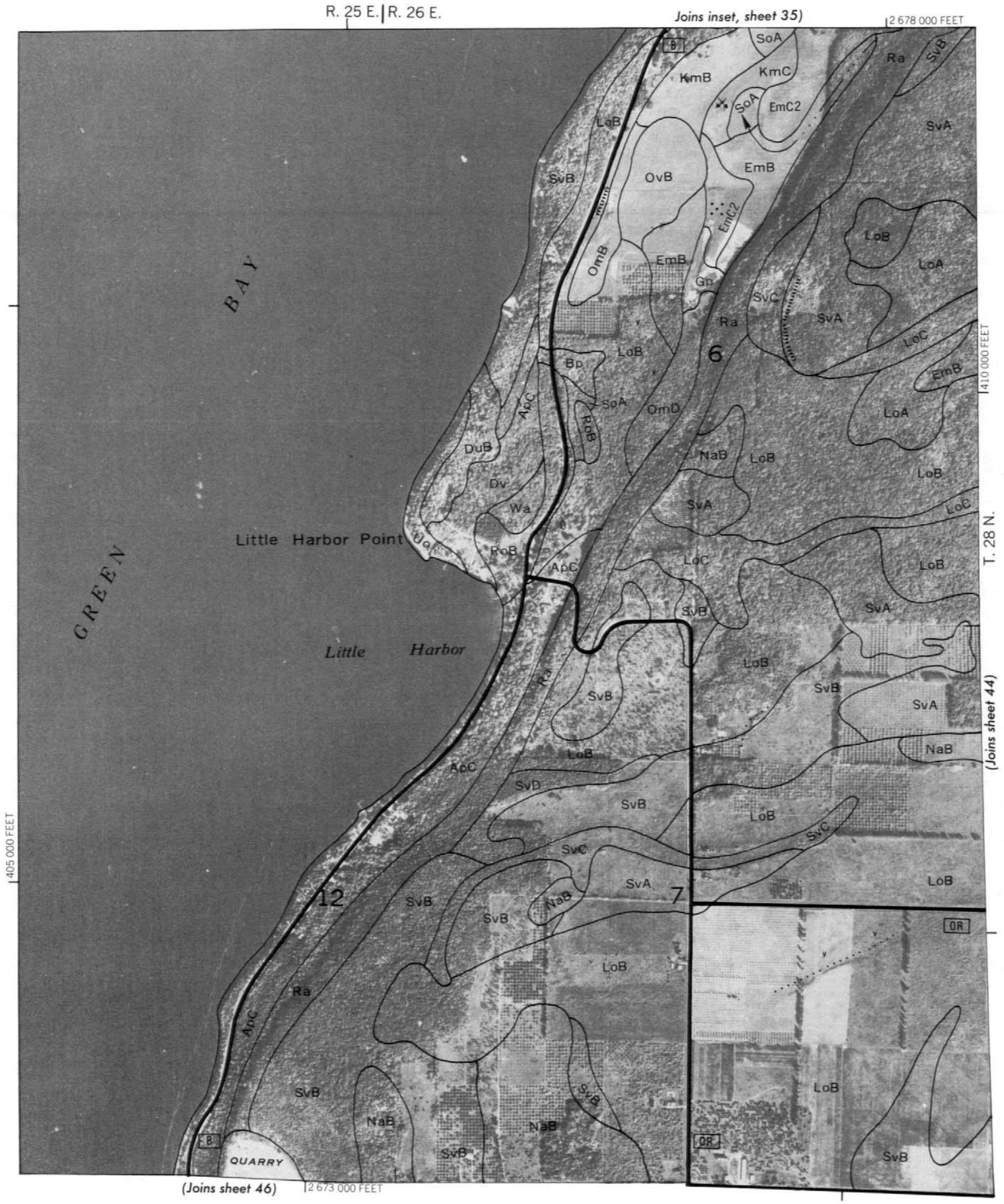
15 14 13 18 22 23 24 19

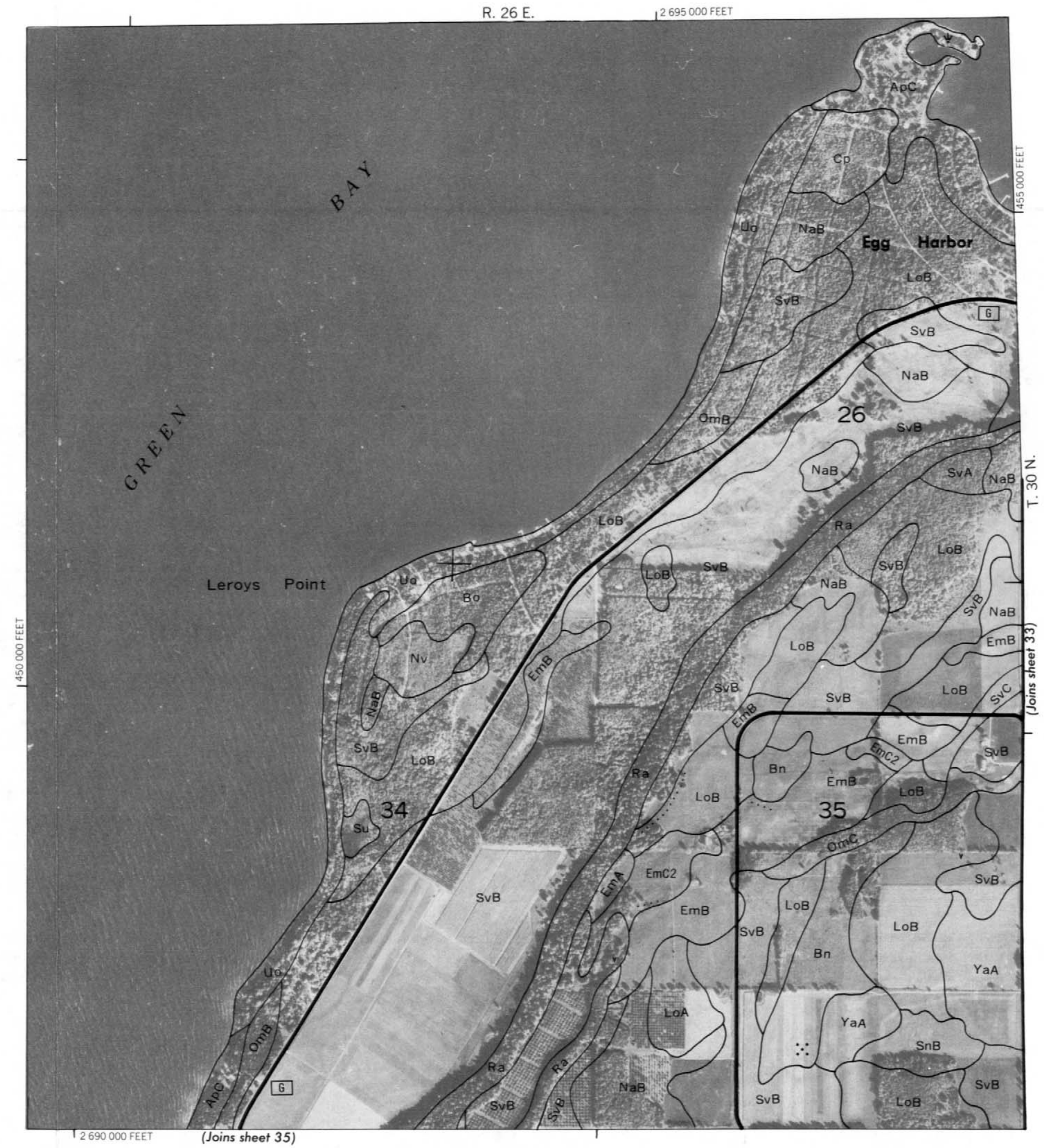
Kangaroo Lake

BAILEYS HARBOR CEMETERY

31
N
1 Mile
5 000 Feet
Scale 1:15 840
0
¼
½
¾
1
1 000
2 000
3 000
4 000
5 000
2 745 000 FEET
R. 28 E.
(Joins sheet 28)
465 000 FEET
T. 30 N.
(Joins sheet 30)
Moonlight Bay
Bailey's Harbor
LAKE MICHIGAN
16
17
15
14
20
21
22
Baileys Harbor
(Joins inset B, sheet 22)
(Joins inset A)
2 760 000 FEET
INSET A
2 750 000 FEET
R. 28 E.
(Joins lower left)
458 000 FEET
456 000 FEET
2 753 000 FEET
2000 AND 3000-FOOT GRID TICKS
INSET B
R. 28 E.
2 762 000 FEET
480 000 FEET
475 000 FEET
2 763 000 FEET
1000 AND 5000-FOOT GRID TICKS
(Joins sheet 28)
CANA ISLAND


32
N
1 Mile
5 000 Feet
Scale 1:15 840


R. 25 E. | R. 26 E.
Joins inset, sheet 35)
2 678 000 FEET
BAY
GREEN
Little Harbor Point
Little Harbor
410 000 FEET
T. 28 N.
(Joins sheet 44)
405 000 FEET
QUARRY
(Joins sheet 46)
2 673 000 FEET
6
7
12


R. 26 E.
2 695 000 FEET
455 000 FEET
BAY
GREEN
Egg Harbor
Leroys Point
T. 30 N.
(Joins sheet 33)
450 000 FEET
2 690 000 FEET
(Joins sheet 35)
26
34
35

DOOR COUNTY, WISCONSIN — SHEET NUMBER 33

33

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

2 700 000 FEET

2 720 000 FEET

1 455 000 FEET

1 450 000 FEET

R. 26 E. | R. 27 E.

T. 30 N.

(Joins sheet 32)

(Joins sheet 29)

(Joins sheet 34)

(Joins sheet 36)

Egg Harbor

Egg Harbor

25 30 29 28 36 31 32 33

water

34

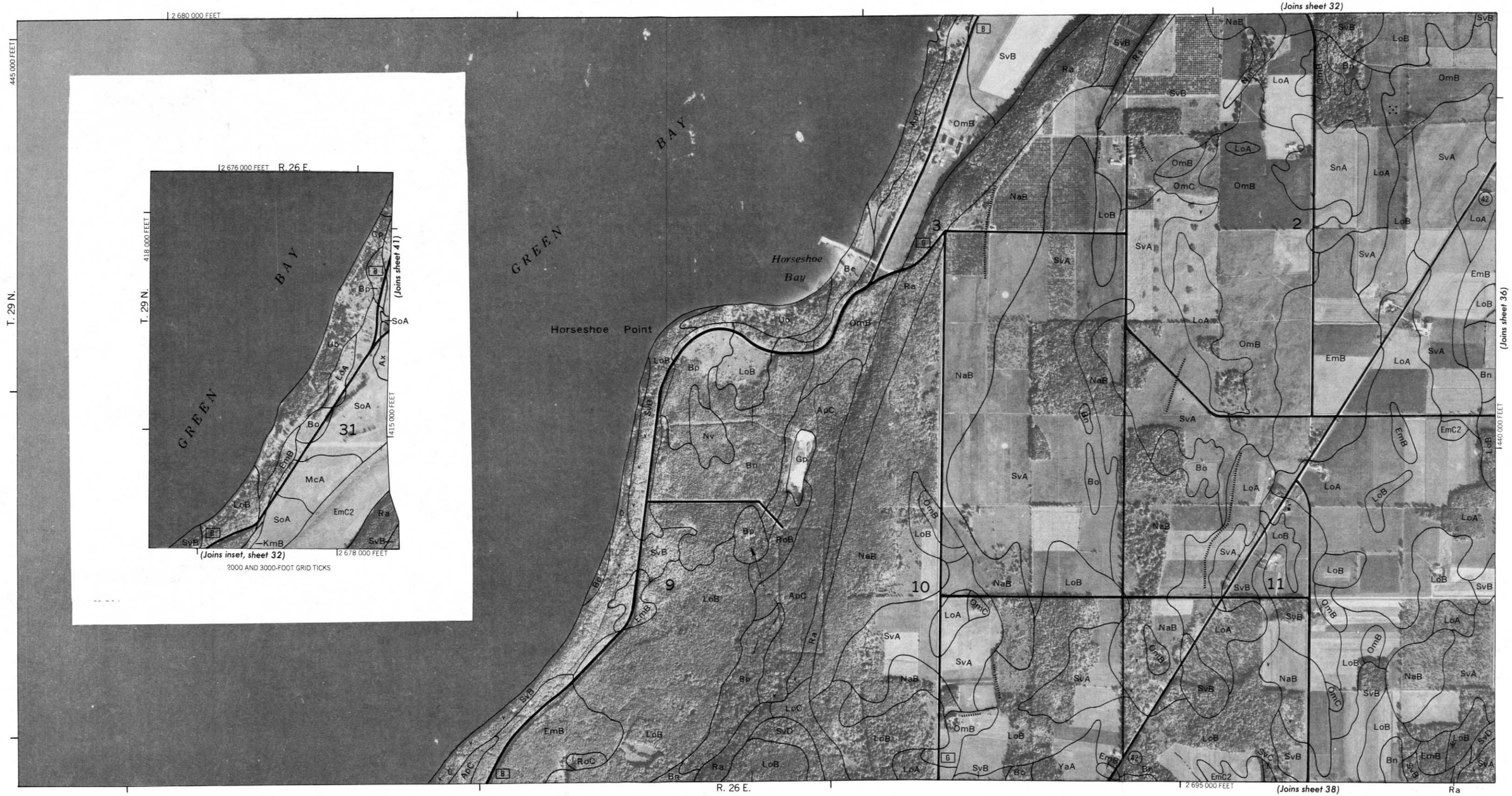
N

1 Mile 5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1 Mile

0 1 000 2 000 3 000 4 000 5 000 Feet



35

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

36

N

1 Mile

5 000 Feet

Scale 1:15 840

0 0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

(Joins sheet 33)

R. 26 E. R. 27 E.

2 720 000 FEET

445 000 FEET

T. 29 N.

440 000 FEET

2 700 000 FEET

(Joins sheet 35)

(Joins sheet 37)

(Joins sheet 39)

Lost Lake

Zion Church

N

2 725 000 FEET

R. 27 E. | R. 28 E.

(Joins sheet 34)

445 000 FEET

T. 29 N.

(Joins sheet 36)

Kangaroo Lake

Hibbard Creek

Herbs Creek

MICHIGAN LAKE

440 000 FEET

2 740 000 FEET

(Joins sheet 40)

1 Mile

5 000 Feet

Scale 1:15 840


38
N
1 Mile
5 000 Feet
Scale 1:15 840
0
1/4
1/2
3/4
1
1 000
2 000
3 000
4 000
5 000
Monument Point
BAY
GREEN
R. 26 E.
T. 29 N.
16
17
20
21
22
23
15
14
2 680 000 FEET
2 695 000 FEET
425 000 FEET
435 000 FEET
(Joins sheet 41)
(Joins sheet 35)
(Joins sheet 39)

39

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

40

N

1 Mile

5 000 Feet

Scale 1:15 840

0 1 000 2 000 3 000 4 000 5 000

(Joins sheet 37)

R. 27 E.

2 730 000 FEET

435 000 FEET

T. 29 N.

430 000 FEET

(Joins sheet 39)

(Joins sheet 43)

2 725 000 FEET

Jacksonport

JACKSONPORT CEMETERY

Lilly Bay Creek

Lilly Bay

LAKE MICHIGAN

13 14 15 22 23

(Joins sheet 52)

R. 26 E.

R. 27 E.

2 710 000 FEET

380 000 FEET

T. 27 N.

375 000 FEET

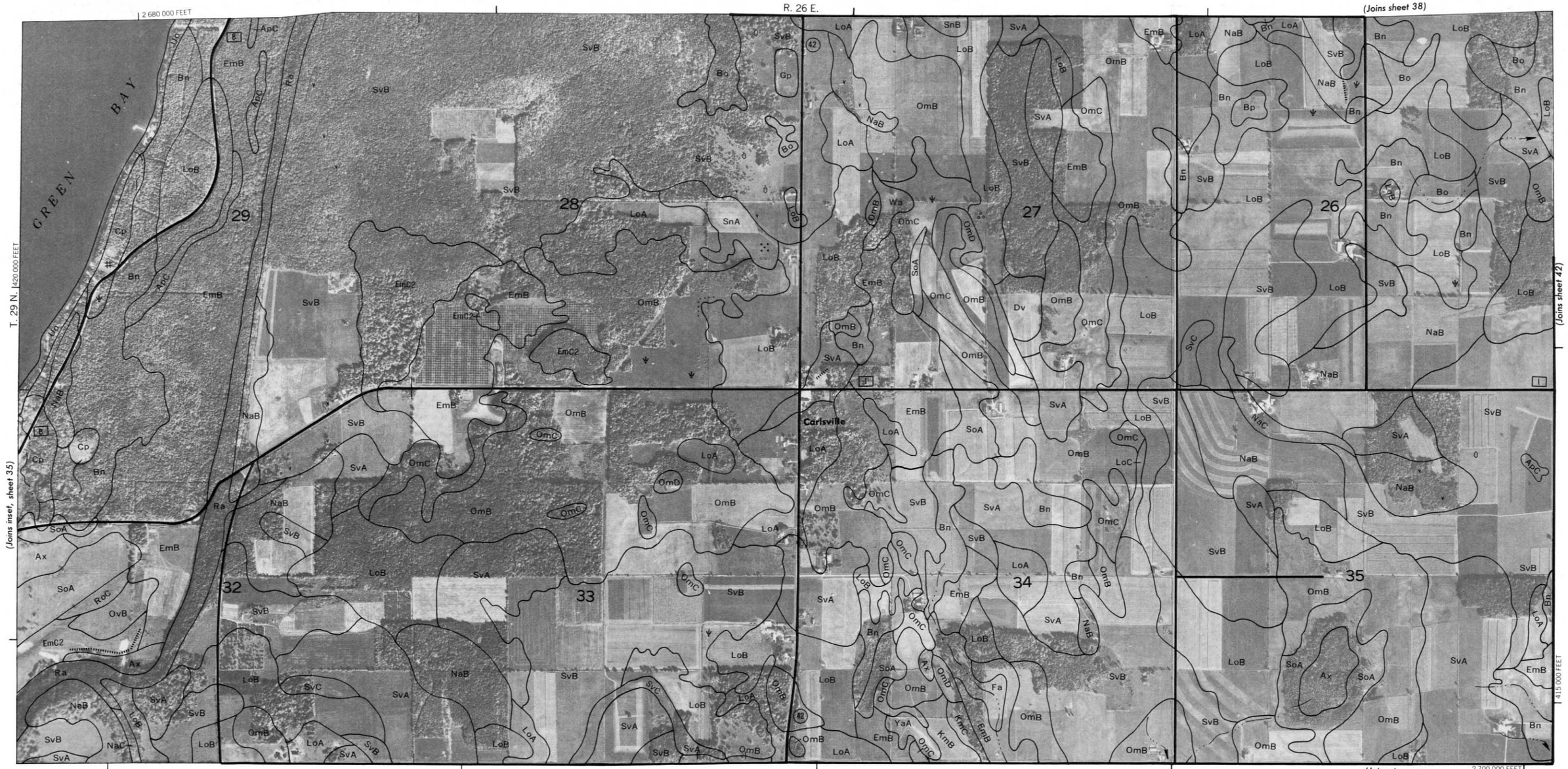
(Joins sheet 56)

(Joins inset, sheet 61)

2 705 000 FEET

1 6 12

water


2 680 000 FEET
R. 26 E.
(Joins sheet 38)
T. 29 N.
420 000 FEET
GREEN BAY
(Joins inset, sheet 35)
(Joins sheet 42)
Carlsville
(Joins sheet 44)
2 700 000 FEET
415 000 FEET
29
28
27
26
32
33
34
35
N
1 Mile
5 000 Feet
Scale 1:15 840

42

N

1 Mile

5 000 Feet

Scale 1:15 840

0 0 ¼ 1 000 ½ 2 000 ¾ 3 000 1 4 000 5 000

R. 26 E. | R. 27 E.

T. 29 N.

(Joins sheet 39)

(Joins sheet 41)

(Joins sheet 43)

(Joins sheet 45)

2 720 000 FEET

2 705 000 FEET

425 000 FEET

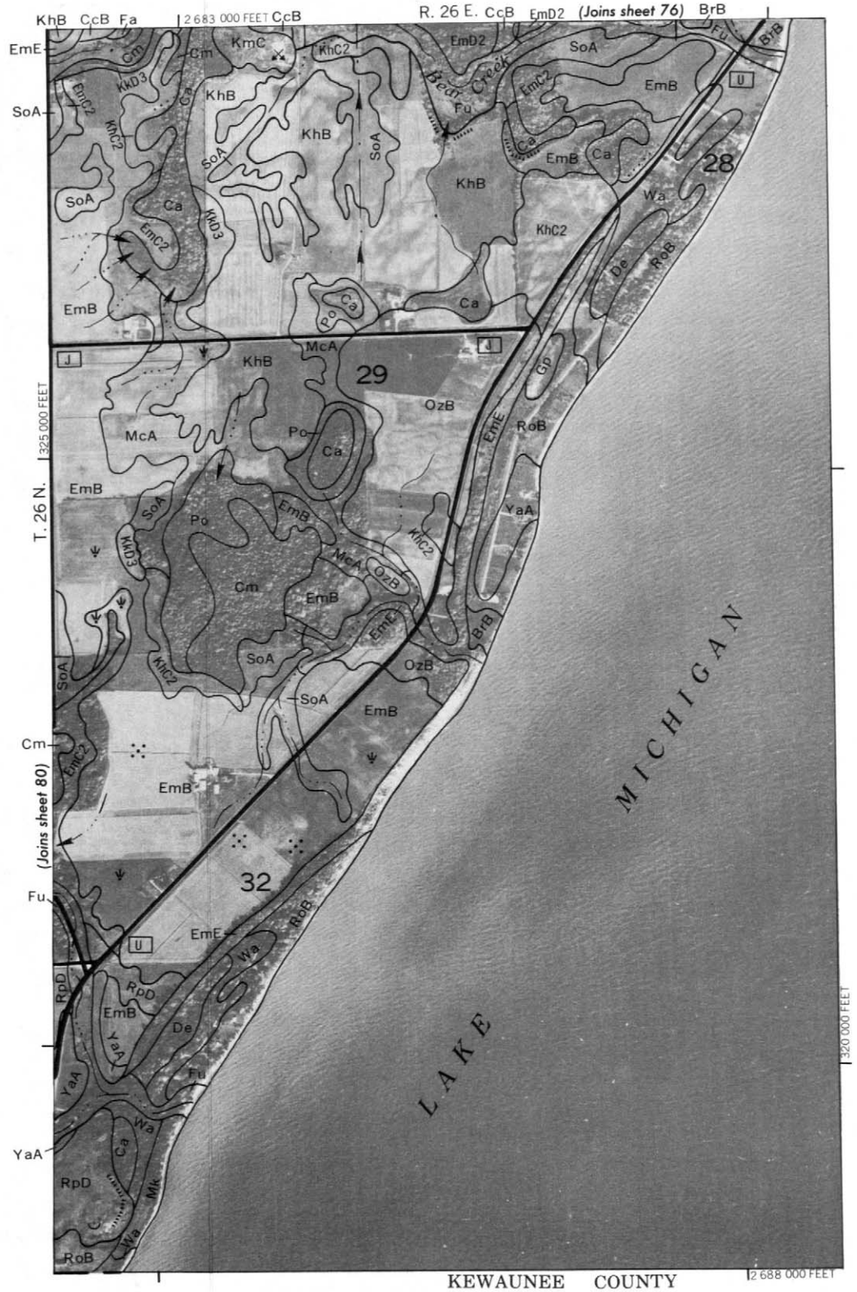
415 000 FEET

Logan Creek

Clark Lake

25 30 29 28 36 31 32 33


R. 27 E.
(Joins sheet 40)
2 725 000 FEET
425 000 FEET
T. 29 N.
MICHIGAN
LAKE
27
26
34
35
water
Clark Lake
Clark Lake
2 730 000 FEET
420 000 FEET
(Joins sheet 42)
(Joins inset, sheet 76)


R. 26 E.
(Joins sheet 76)
2 683 000 FEET
T. 26 N.
325 000 FEET
MICHIGAN
LAKE
28
29
32
(Joins sheet 80)
320 000 FEET
KEWAUNEE COUNTY
2 688 000 FEET

43
N
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000


N
(Joins sheet 41)
R. 26 E.
2 700 000 FEET
T. 28 N.
410 000 FEET
(Joins sheet 45)
(Joins inset, sheet 32)
405 000 FEET
2 680 000 FEET
(Joins sheet 47)
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000
¼
½
¾
1

N

R. 26 E. | R. 27 E.

2 705 000 FEET

T. 28 N.

410 000 FEET

(Joins sheet 42)

(Joins inset, sheet 76)

(Joins sheet 44)

(Joins sheet 48)

2 720 000 FEET

405 000 FEET

St. Johns Church

Volmy

Maple Creek

Whitefish Bay Creek

water

1 Mile

5 000 Feet

Scale 1:15 840


46
N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins inset, sheet 32)
(Joins sheet 47)
(Joins sheet 50)
(Joins sheet 53)
R. 25 E.
R. 26 E.
R. 24 E.
T. 28 N.
2 675 000 FEET
2 660 000 FEET
2 635 000 FEET
2 630 000 FEET
400 000 FEET
395 000 FEET
382 000 FEET
381 000 FEET
1000 AND 5000-FOOT GRID TICKS
GREEN BAY
STURGEON BAY
Henderson Point
Sherwood Point
Cabot Point
Idlewild
Sawyer Harbor
QUARRY
13
18
19
22
23
33
34
35

DOOR COUNTY, WISCONSIN — SHEET NUMBER 47

47

N

2 680 000 FEET

R. 26 E.

(Joins sheet 44)

400 000 FEET

T. 28 N.

(Joins sheet 48)

(Joins sheet 46)

395 000 FEET

2 700 000 FEET

(Joins sheet 51)

1 Mile

5 000 Feet

Scale 1:15 840

0 0 ¼ ½ ¾ 1

5 000 4 000 3 000 2 000 1 000 0

48

N

1 Mile

5 000 Feet

Scale 1:15 840

(Joins sheet 45)

R. 26 E. | R. 27 E.

2 720 000 FEET

400 000 FEET

T. 28 N.

(Joins sheet 47)

(Joins sheet 52)

2 705 000 FEET

395 000 FEET

(Joins inset, sheet 65)

13 18 17 16 24 19 20 21

water

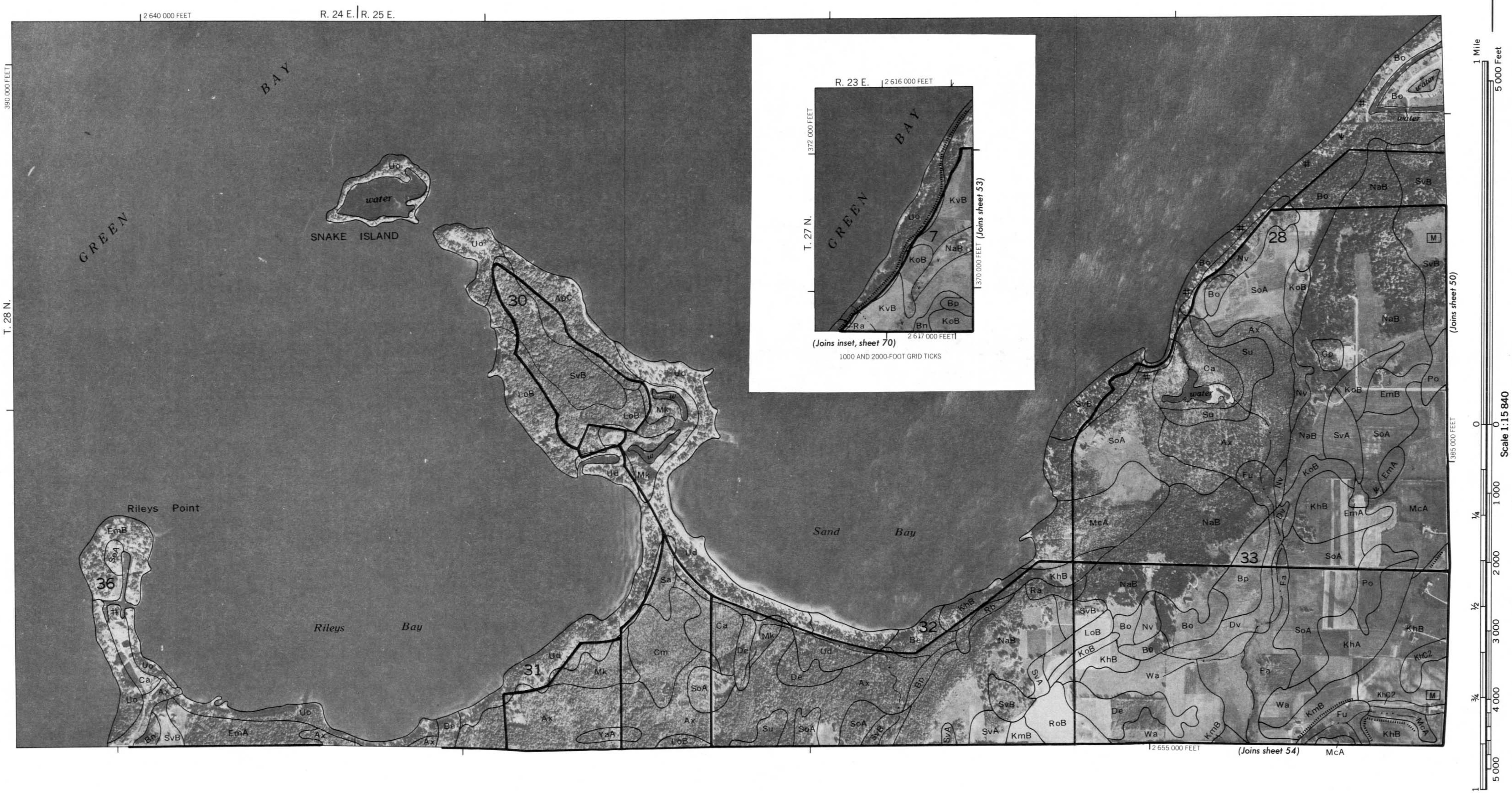
Institute

Maple Creek

Whitefish Bay

Mud Lake

Schmake Lake


N
2 640 000 FEET
R. 24 E.
R. 25 E.
390 000 FEET
T. 28 N.
GREEN BAY
SNAKE ISLAND
water
Rileys Point
Rileys Bay
Sand Bay
30
36
31
32
33
28
R. 23 E.
2 616 000 FEET
372 000 FEET
T. 27 N.
GREEN BAY
(Joins sheet 53)
370 000 FEET
2 617 000 FEET
(Joins inset, sheet 70)
1000 AND 2000-FOOT GRID TICKS
(Joins sheet 50)
385 000 FEET
2 655 000 FEET
(Joins sheet 54)
1 Mile
5 000 Feet
Scale 1:15 840

50

N

1 Mile

5 000 Feet

Scale 1:15 840

0 0 ¼ 1 000 ½ 2 000 ¾ 4 000 1 5 000

R. 25 E. | R. 26 E.

2 680 000 FEET

390 000 FEET

T. 28 N.

(Joins sheet 46)

(Joins sheet 49)

(Joins sheet 51)

(Joins sheet 55)

2 660 000 FEET

385 000 FEET

Quarry Point

STURGEON BAY

POTAWATOMI STATE PARK

Hills Point

HAINESVILLE CEMETERY

BAYSIDE CEMETERY

QUARRY

26

27

30

31

34

35

36

DOOR COUNTY, WISCONSIN — SHEET NUMBER 51

51

N

1 Mile

5 000 Feet

Scale 1:15 840


N
1 Mile
5 000 Feet
Scale 1:15 840
0
1000
2000
3000
4000
5000
¼
½
¾
1
(Joins sheet 48)
R. 26 E.
R. 27 E.
2 720 000 FEET
(Joins sheet 51)
(Joins inset, sheet 65)
390 000 FEET
385 000 FEET
T. 28 N.
(Joins inset, sheet 40)
2 705 000 FEET
Maple Creek
Mud Lake
Shivering Sands Creek
water
LAKE MICHIGAN
Lilly Bay Creek
25
30
29
28
36
31
32
SoA
EmB
LoB
LoA
SvB
SvA
NaB
OmB
OmC
LoC
Cm
Ca
Mk
RrB
RoB
RoC
RpC
Ax
KmC
KmB
EmC2
Bn
Gp
Bp
Cp
De
Dv
DuB
Wa
Ud
Nv
Cp
Mk
RoC
R. 23 E.
2 597 000 FEET
T. 26 N.
GREEN BAY
340 000 FEET
338 000 FEET
(Joins sheet 66)
9
ApC
McA
KhB
Bn
2 596 000 FEET
(Joins sheet 71)
1000 AND 2000-FOOT GRID TICKS

N

R. 24 E.

2 620 000 FEET

380 000 FEET

T. 27 N.

GREEN BAY

LITTLE STURGEON BAY

Little Sturgeon

Squaw Island

(Joins inset, sheet 46)

(Joins sheet 54)

(Joins inset, sheet 49)

(Joins sheet 57)

2 635 000 FEET

370 000 FEET

1 Mile

5 000 Feet

Scale 1:15 840

54

N

1 Mile

5 000 Feet

Scale 1:15 840

DOOR COUNTY, WISCONSIN — SHEET NUMBER 55

55

N

R. 25 E. | R. 26 E.

T. 27 N.

2 660 000 FEET

380 000 FEET

(Joins sheet 50)

(Joins sheet 54)

(Joins sheet 56)

(Joins sheet 59)

2 680 000 FEET

375 000 FEET

DOOR COUNTY AIRPORT

CHERRYLAND

STURGEON BAY

(county seat)

Bradley Lake

Cunningham Swamp

QUARRY

1 Mile

5 000 Feet

Scale 1:15 840

56

N

1 Mile

5 000 Feet

Scale 1:15 840

R. 26 E.

T. 27 N.

2 700 000 FEET

380 000 FEET

375 000 FEET

2 685 000 FEET

(Joins sheet 51)

(Joins sheet 55)

(Joins sheet 60)

(Joins inset, sheet 40)

STURGEON BAY (county seat)

STURGEON BAY

Stevens Hill

QUARRY

Water

1 2 3 4 5 6 7 8 9 10 11


2 620 000 FEET
R. 24 E.
(Joins sheet 53)
T. 27 N.
365 000 FEET
17
16
15
14
20
21
22
23
Keyes Creek
Au Grande Maret
(Joins inset, sheet 70)
(Joins sheet 58)
2 635 000 FEET
360 000 FEET
(Joins sheet 62)
57
N
1 Mile
5 000 Feet
Scale 1:15 840

58

N

1 Mile

5 000 Feet

Scale 1:15 840

0 0 ¼ 1 000 ½ 2 000 ¾ 4 000 1 5 000

59

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

60

N

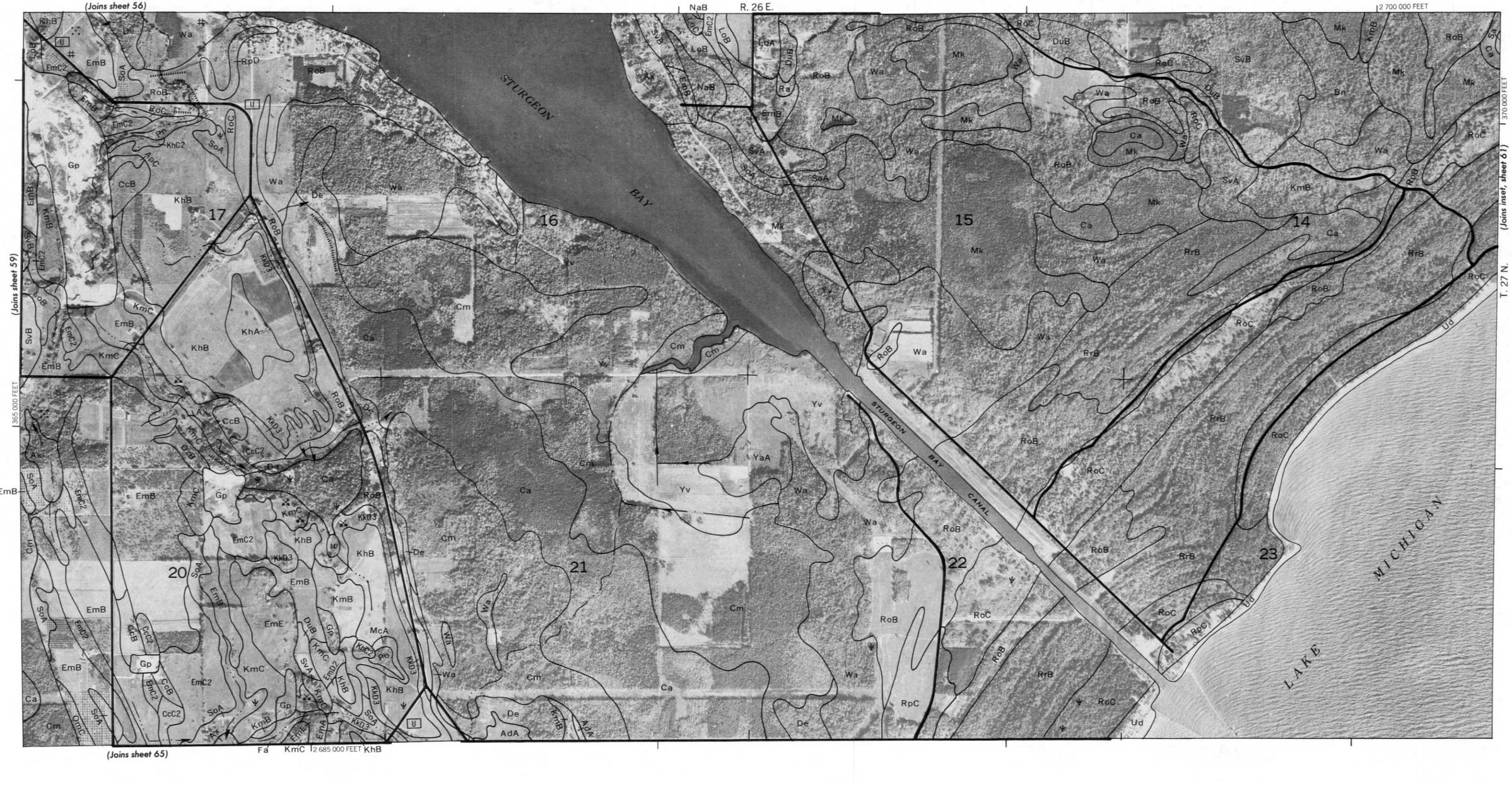
1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000



N

2 600 000 FEET

R. 26 E. (Joins inset, sheet 40)

2 702 000 FEET

T. 27 N.

355 000 FEET

371 000 FEET

368 000 FEET

(Joins sheet 60)

water Sa Ce Bp RpA RrB RoB RoC Ud 13 Portage Point LAKE MICHIGAN

2 705 000 FEET

3000-FOOT GRID TICKS

R. 23 E. | R. 24 E.

(Joins inset, sheet 70)

GREEN BAY

Sugar Creek

White Star Church

WHITE STAR CEMETERY

25 26 30 35 36 31 34

(Joins sheet 62)

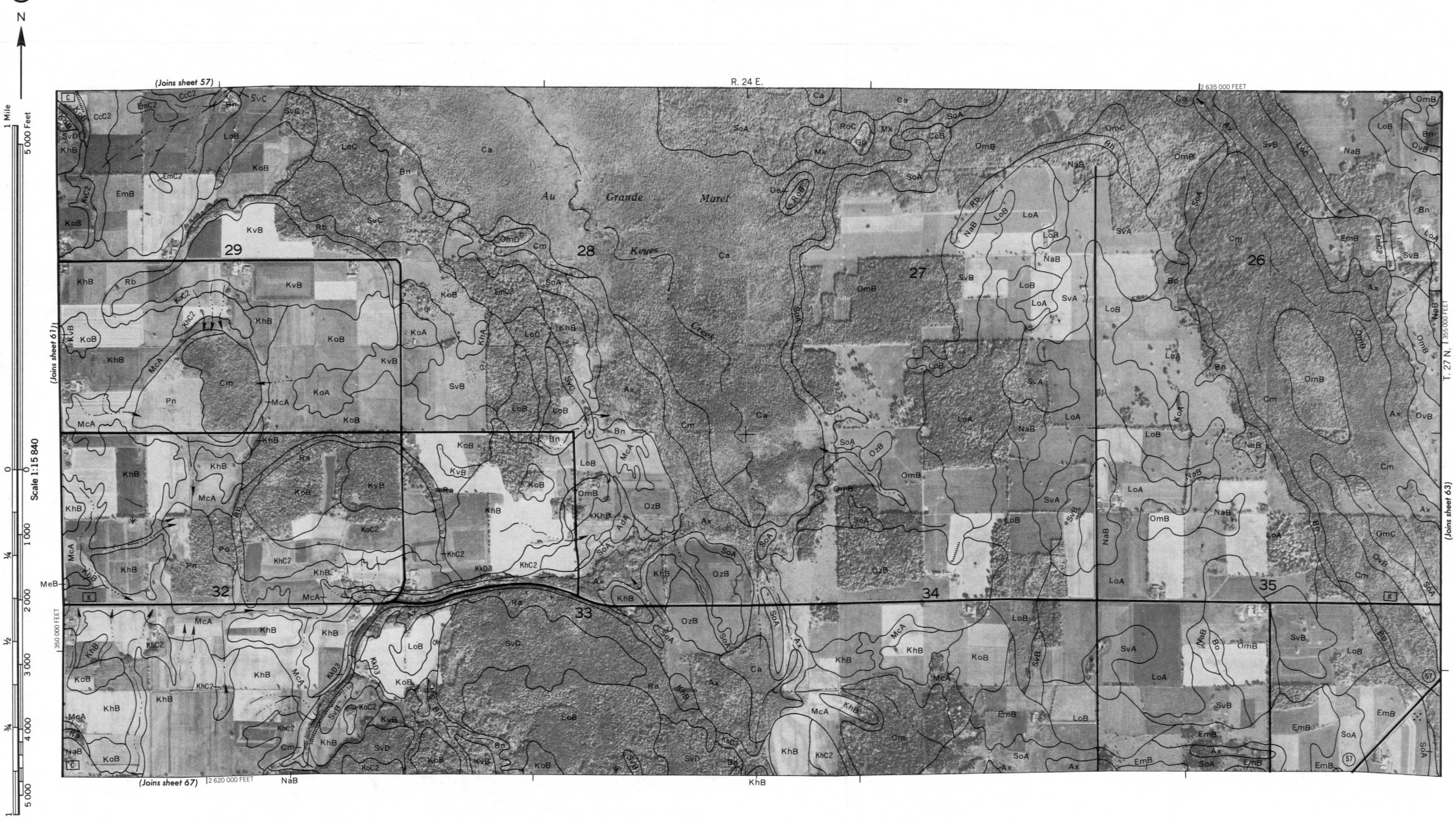
2 615 000 FEET

(Joins sheet 66)

1 Mile

5 000 Feet

Scale 1:15 840


62
N
1 Mile
5 000 Feet
0
Scale 1:15 840
1 000
2 000
3 000
4 000
5 000
1/4
1/2
3/4
(Joins sheet 57)
R. 24 E.
2 635 000 FEET
(Joins sheet 61)
T. 27 N.
355 000 FEET
(Joins sheet 63)
350 000 FEET
(Joins sheet 67)
2 620 000 FEET
Au Grande Marel
Keyes Creek
29
28
27
26
32
33
34
35

63

N

R. 24 E. | R. 25 E.

2 640 000 FEET

T. 27 N.

355 000 FEET

(Joins sheet 58)

(Joins sheet 64)

(Joins sheet 62)

(Joins sheet 68)

350 000 FEET

2 660 000 FEET

25 30 29 28 36 31 32 33

CEISE CEMETERY

Maplewood Swamp

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

64

N

1 Mile 5 000 Feet

Scale 1:15 840

0 1 000 2 000 3 000 4 000 5 000

(Joins sheet 59)

(Joins sheet 63)

(Joins sheet 69)

(Joins sheet 65)

R. 25 E. R. 26 E.

T. 27 N.

2 680 000 FEET

360 000 FEET

350 000 FEET

2 665 000 FEET

25 26 27 30 31 34 35 36

Stony Creek Swamp

Strutt Creek

(Joins sheet 60)

R. 26 E.

R. 27 E.

2 685 000 FEET

2 723 000 FEET

2 700 000 FEET

360 000 FEET

355 000 FEET

398 000 FEET

393 000 FEET

T. 27 N.

T. 28 N.

Shiloh Church

Mt. Olive Church

MT. OLIVE CEMETERY

Rocky Point

Whitefish Point

Whitefish Bay

LAKE MICHIGAN

29

28

27

32

33

34

22

(Joins sheet 64)

(Joins sheet 70)

(Joins sheet 52)

(Joins sheet 48)

1000 AND 5000-FOOT GRID TICKS

N

1 Mile

5 000 Feet

Scale 1:15 840

66

N

1 Mile

5 000 Feet

Scale 1:15 840

0 0 ¼ 1 000 ½ 2 000 ¾ 4 000 1 5 000

R. 23 E. | R. 24 E.

2 615 000 FEET

(Joins sheet 61)

345 000 FEET

T. 26 N.

340 000 FEET

(Joins inset, sheet 52)

(Joins sheet 72)

2 600 000 FEET

(Joins sheet 67)

GREEN BAY

Fairland

St. Francis Church

Brussels

1 2 3 4 5 6 7 8 9 10 11 12

67

N

2 620 000 FEET

R. 24 E.

(Joins sheet 62)

345 000 FEET

T. 26 N.

(Joins sheet 68)

(Joins sheet 66)

340 000 FEET

2 635 000 FEET

(Joins sheet 73)

Brussels

1 Mile

5 000 Feet

Scale 1:15 840

0 0 ¼ 1 000 ½ 2 000 ¾ 3 000 1 4 000 5 000


N
1 Mile
5 000 Feet
Scale 1:15 840
0
1/4
1/2
3/4
1
0
1 000
2 000
3 000
4 000
5 000
(Joins sheet 63)
R. 24 E.
R. 25 E.
2 660 000 FEET
(Joins sheet 67)
(Joins sheet 69)
345 000 FEET
T. 26 N.
340 000 FEET
2 640 000 FEET
(Joins sheet 74)
Maplewood
Almanac River
Stony Creek
1
4
5
6
7
8
9
12
42

N

R. 25 E. | R. 26 E.

T. 26 N.

2 665 000 FEET

345 000 FEET

340 000 FEET

2 680 000 FEET

(Joins sheet 64)

(Joins sheet 68)

(Joins sheet 70)

(Joins sheet 75)

1 Mile

5 000 Feet

Scale 1:15 840

70

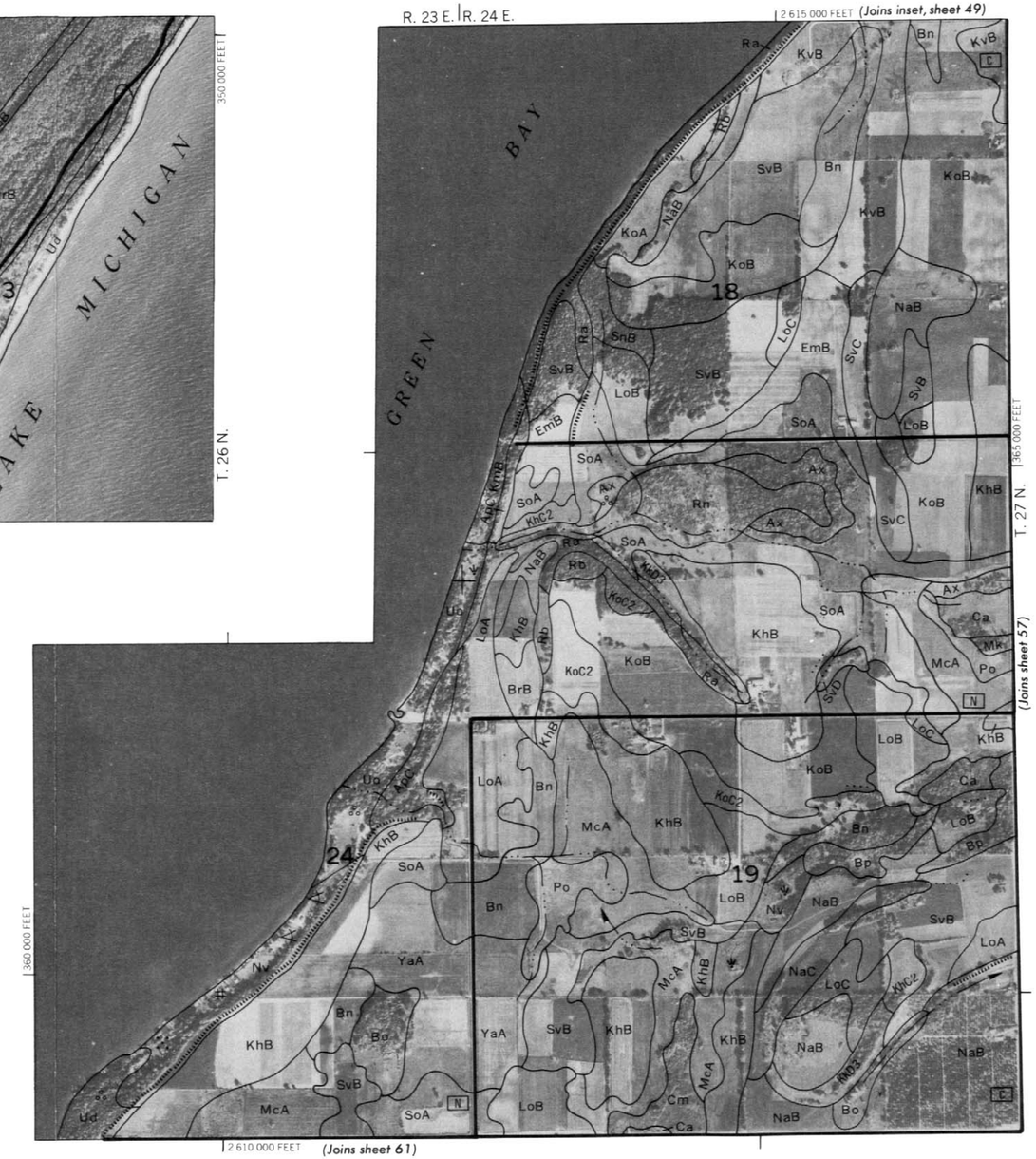
N

1 Mile

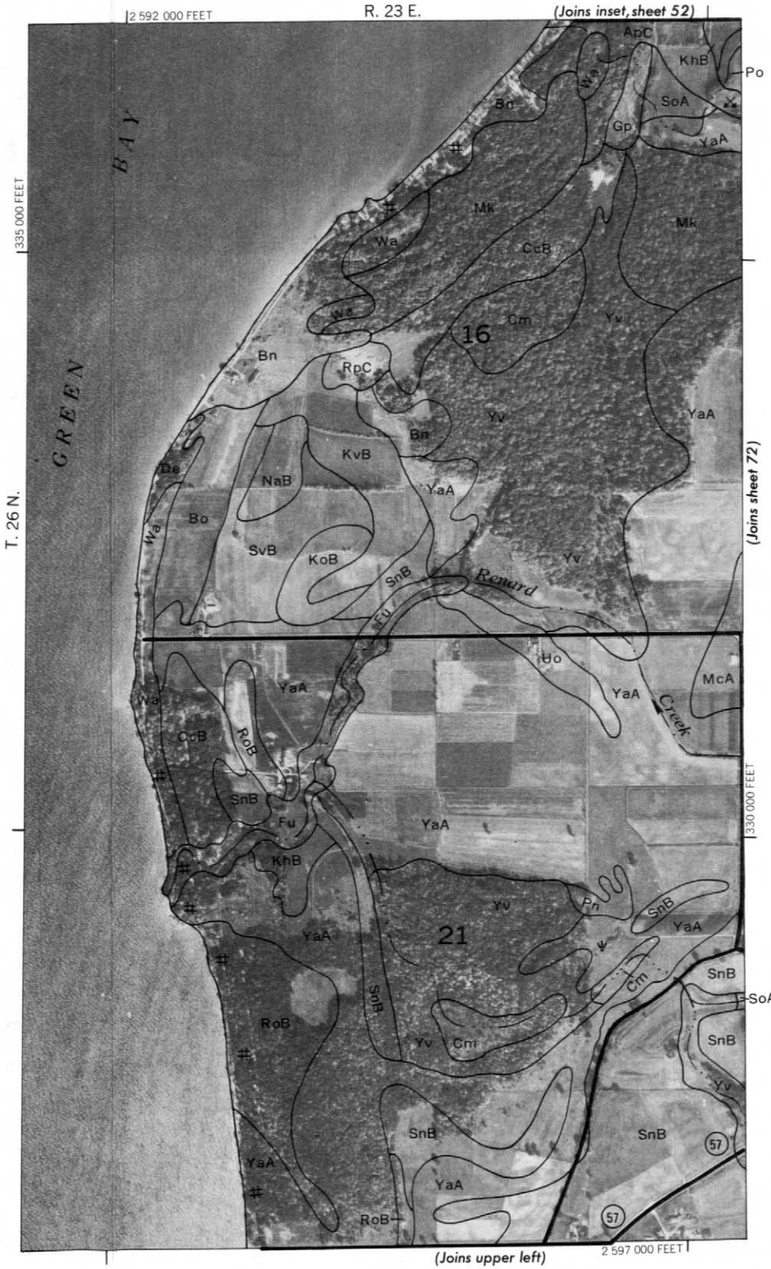
5 000 Feet

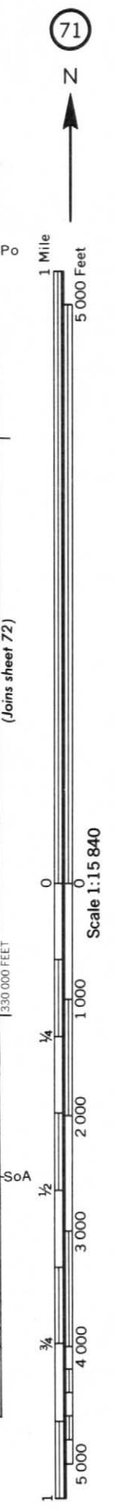
Scale 1:15 840

0 0 1/4 1 000 1/2 2 000 3/4 4 000 1 5 000




2 590 000 FEET
R. 23 E.
(Joins lower right)
325 000 FEET
T. 26 N.
BAY
GREEN
28
32
33
57
DUVALL CEMETERY
(Joins sheet 77)
320 000 FEET
KEWAUNEE COUNTY
2 595 000 FEET


2 592 000 FEET
R. 23 E.
(Joins inset, sheet 52)
335 000 FEET
T. 26 N.
BAY
GREEN
16
21
57
Renard Creek
(Joins sheet 72)
330 000 FEET
(Joins upper left)
2 597 000 FEET


71
N
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000

72

N

1 Mile

5 000 Feet

Scale 1:15 840

0 0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

(Joins sheet 66)

R. 23 E. | R. 24 E.

2 615 000 FEET

335 000 FEET

T. 26 N.

330 000 FEET

(Joins sheet 71)

(Joins sheet 73)

(Joins sheet 77)

2 600 000 FEET

Fairland

ST. MARY'S CEMETERY

Brussels

Creek

15 14 13 18 22 23 24 19

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

2 620 000 FEET

2 635 000 FEET

335 000 FEET

330 000 FEET

T. 26 N.

R. 24 E.

Brussels

Kohlberg

17 16 15 14 20 21 22 23

(Joins sheet 67)

(Joins sheet 74)

(Joins sheet 72)

(Joins sheet 78)

QUARRY

74

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

R. 24 E. | R. 25 E.

2 660 000 FEET

330 000 FEET

335 000 FEET

T. 26 N.

(Joins sheet 68)

(Joins sheet 73)

(Joins sheet 75)

(Joins sheet 79)

2 640 000 FEET

Fu

13 18 17 16 24 19 20 21 42

Ax SoA YaA EmB OmB Ra KvB KoB KvC2 KoA SvB LoA KhB EmA Rb Bn OmC OvB Nv KhC2 Cm Ahnapee River NaB EmC2 Gp SoA Mk OzB Ca Su BrB BrC SnB CcB McA Po Pn Sa Bp LoC water QUARRY SvC SvD NaC KhA ST MARY CEMETERY


R. 25 E.
R. 26 E.
T. 26 N.
2 665 000 FEET
335 000 FEET
2 680 000 FEET
330 000 FEET
(Joins sheet 69)
(Joins sheet 74)
(Joins sheet 76)
(Joins sheet 80)
15
14
13
18
22
23
24
19
Creek
Vignes
Carnot
Scale 1:15 840
1 Mile
5 000 Feet

76

N

1 Mile 5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

(Joins sheet 70) R. 26E. 2 690 000 FEET

T. 26 N.

335 000 FEET

330 000 FEET

(Joins sheet 75)

Ca KmC (Joins inset, sheet 43) 2 685 000 FEET Fu BrB

Ax R. 27E. 2 730 000 FEET (Joins sheet 43)

T. 28 N.

415 000 FEET

405 000 FEET

(Joins sheet 45)

2 725 000 FEET

Clark Lake

Cave Point

MICHIGAN LAKE MICHIGAN

CLAYBANKS CEMETERY

Vignes

Schuyler Creek

Wanderer Creek

Whitefish Bay

17 16 20 21 3 2 10

77

N

1 Mile

5 000 Feet

Scale 1:15 840

0 0

¼ 1 000

½ 2 000

¾ 4 000

1 5 000

78

N

1 Mile 5 000 Feet 0

Scale 1:15 840

0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

(Joins sheet 73)

R. 24 E.

2 635 000 FEET

325 000 FEET

T. 26 N.

(Joins sheet 77)

(Joins sheet 79)

320 000 FEET

2 620 000 FEET

KEWAUNEE COUNTY

Rosiere

29 28 27 26

32 33 34 35

79

N

1 Mile 5 000 Feet

Scale 1:15 840

0 1 000 2 000 3 000 4 000 5 000

80

N

1 Mile

5 000 Feet

Scale 1:15 840

(Joins sheet 75)

(Joins sheet 79)

R. 25 E.

R. 26 E.

2 680 000 FEET

325 000 FEET

T. 26 N.

320 000 FEET

2 665 000 FEET

KEWAUNEE COUNTY

(Joins inset, sheet 43)

Carnot

Creek

27 26 25 30 34 35 36 31